

A R I T H M E T I C

FOR

UNIVERSITY EXAMINATIONS

SCOTLAND

New Edition



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**ANSWERS to the Exercises, printed separately, may be had through
the Publishers. Price 6d.**

P R E F A C E.

THIS book is primarily intended as a guide to pupils preparing for the University Local and Medical Preliminary Examinations in Arithmetic.

It contains all the arithmetical exercises set in the Local Examinations conducted by the Scottish Universities, together with numerous exercises selected from the Medical Preliminary Examinations in Arithmetic at Edinburgh and Glasgow, the Bursary and Entrance Examinations, and the M.A. Pass Examinations at Edinburgh University.

Certain easily-understood contractions have been placed beside all the University Local questions, indicating the place where, the time when, and the paper in which each question was set. Each University is denoted by its first letter; the figures '18' are omitted from the dates; questions from the Junior Mathematical Papers are marked by an asterisk (*), and those from the Senior by a dagger (†); while those from the Preliminary Arithmetic Papers have no distinctive mark.

Thus (E. 78.) means—set in the *Preliminary Arithmetic Paper* at *Edinburgh* in 1878.

(* G. 79.) means—set in the *Junior Mathematical Paper* at *Glasgow* in 1879.

(† S. 80.) means—set in the *Senior Mathematical Paper* at *St Andrews* in 1880.

Questions selected from the Medical Preliminary Examination Papers are followed by the mark (E.) of (G.), the date being omitted.

The questions have been grouped under the various rules and carefully graduated, so that the book may be used as an ordinary class-book. It may also be conveniently used for Revision or Test purposes with senior pupils who have worked through a systematic text-book. In particular, the additional examples in Exercise XVIII. should afford stimulating and profitable exercise to the most advanced classes in Secondary Schools.

September 1886.

N O T E.

IN order to bring this edition up to date, sixteen pages of new matter have been added, including nearly all the questions set in the University Local Preliminary and the Medical Preliminary Arithmetical Examinations for the last three years. The papers set by the Scotch Educational Department in 1888 and 1889 for the Leaving Certificates in Arithmetic have also been given.

August 1889.

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ARITHMETIC

FOR

UNIVERSITY EXAMINATIONS.

EXERCISE I.

NOTATION, NUMERATION, AND SIMPLE RULES.

1. Express 600407032 in words. (E.)
2. Write down in words the following numbers:
1376428572, 630040212, 13000108. (G. 79.)
3. Express in Arabic numerals, Nine hundred and seven millions eighty thousand seven hundred and one; and in words the number 8070603. (G.)
4. Express in figures Five millions thirty thousand and fifty-two. (A. 80.)
5. Express in figures One thousand three hundred and twelve millions ninety-six thousand and forty-two; and write down in words 96452386. (G. 78.)
6. Express in figures Eleven thousand eleven hundred and eleven. (E.)
7. Add Seven hundred and thirty thousand six hundred and forty-three, nine thousand and fifty-four, twenty-five millions sixty-seven thousand four hundred and nine, five hundred and fifty-five millions six hundred and sixty-six thousand seven hundred and seventy-seven, eighty-eight, sixty millions six thousand and six, ninety-seven millions fifty-four thousand six hundred and seventy-four. Give your answer in *words* as well as figures. (E. 77.)

8. Add together 43285, 69297, 3520, and 432, and from the sum subtract 39478. (G. 78.)
9. Add together the numbers 68435, 4876, 13962, 47, 368, 54796, 3789, and from the sum subtract 97528. (G. 82.)
10. Add together 187156, 38074, 52893, 62875. Add also 97843, 62740, 2308, 532, and find the difference of the two sums. (G. 79.)
11. Add together 369276, 48754, 864, 9765, and 27. Add also 286, 9375, 26, 3984, and 20036. Subtract the latter sum from the former, and write down in words the difference so found. (G. 80.)
12. Add together 987538, 348692, 87567, 379, 4586, 37429. Add also 643, 7074, 67, 83945, 295633, and 7472, and subtract the latter sum from the former. (G. 81.)
13. A man died in 1879 at the age of 93, and his son in 1865 at 57. How old was the father when the son was born? (E.)
14. A man died in 1877 at 89 years of age; his son in 1860 at 49. How old was the father when the son was born? (E. 78.)
15. Simplify $4896 - 2643 - 3120 + 7648 - 6215$. (E.)
16. Multiply 13579 by 24680. (E.)
17. Multiply One thousand millions one hundred thousand one hundred and one by One hundred thousand one hundred and one. (E.)
18. Multiply 67081 by 35972, and express the result in words. (E. 76.)
19. Multiply Three hundred and forty-five thousand and twenty-seven by Five thousand seven hundred and nine. Write the answer in words. (E. 78.)
20. Multiply Eighty millions thirty thousand and seventy-nine by Seventy thousand and fifty-nine. (A. 81.)
21. Multiply 23456 by 996; subtract 4 times 23456 from 23456000, and find the difference between the two results. (S. 84.)

22. Add together three times one hundred and twenty-five thousand, four times seven thousand and seventeen, and five times three hundred thousand two hundred and six. (E. 71.)
23. Subtract Seven hundred and ninety thousand and eighty from One million six thousand and three, and multiply the difference by Nine hundred thousand six hundred and seven. (A. 84.)
24. Write in words: 112800223922 and 30047; and divide the one number by the other. (A. 85.)
25. Divide 169316913 by 12192, and express the quotient in words. (S. 79.)
26. Divide 14544293 by 2479. (A. 80.)
27. Divide Six billions seven hundred and seventy-seven millions forty-five thousand and twenty-eight by Three thousand and four. (S. 81.)
28. Divide Two millions four hundred and ninety thousand two hundred and one by Four thousand and eighty-nine. (S. 82.)
29. Divide Three hundred and ninety-six millions four hundred and one thousand and five by Seven hundred and fifteen. (E.)
30. Find the quotient of Fifty-seven millions six thousand and seventy divided by Six thousand and sixty-seven. (S. 84.)
31. Divide 500700270180 by 5006. (E.)
32. Divide 39473 by 35, by short division. (+ E. 76.)
33. The population of Great Britain is 35,262,762, and the area is 120,830 square miles; what is the average density of the population? (E.)
34. Divide Three millions seventeen thousand and forty-nine by Sixty-three, and subtract the quotient from a million. (E. 74.)
35. Add together Thirty thousand three hundred, five hundred thousand and five, two millions twenty thousand and thirty, thirty millions three hundred and five, fifty thousand. (S. 83.)

36. Divide the above sum by Eighty, and express the answer in words. (S. 83.)
37. From One hundred and forty millions twenty thousand seven hundred and one, subtract Eleven millions five hundred and three thousand and thirty-eight. Divide the result by Eighteen hundred and ninety-three. (G.)
38. From Three hundred and seventy-two millions six hundred and eighty-six thousand three hundred and seventy-three, subtract Seventy-six millions thirty-two thousand one hundred and fifty-six, and divide the remainder by Three thousand four hundred and fifty-nine. (G.)
39. Multiply 639754 by 7986, and divide the product by 42837. (G. 78.)
40. Multiply 38745 by 6783, and divide the product by 8745. (G. 79.)
41. Multiply 387623 by 9869, and divide the product by 76432. (G. 80.)
42. Multiply 39867 by 7354, and divide the product by 8359. (G. 81.)
43. Multiply 4968 by 5829, and divide the product by 7479. (G. 82.)
44. Multiply 97598 by 8397; and divide 73694857 by 34876. (G. 83.)
45. Multiply 78594 by 3674, and divide the product by 9639. (G. 84.)
46. Multiply 38304 by 5872, and divide the product by 6384. (G. 85.)
47. Add together Twenty millions sixty thousand and twenty-eight, and seven hundred thousand nine hundred and eighty-nine; and divide the sum by Eighty thousand and ninety-seven. (A. 83.)
48. Add together Sixty-one millions four thousand three hundred and sixty, one hundred and fifty-four thousand and four, seventy-nine billions and forty, and seventy-eight; multiply this sum by 5005; divide the product by 5, and express the result in words. (S. 78.)

49. Divide the product of 5093 and 8007 by the sum of 857 and 108. (A. 82.)
50. Find the product of the sum and difference of 119 and 17, and find the quotient of the answer by 48. (E.)
51. Find the value of $16042 \times 71617 \div 8638$. Express the answer both in words and figures. (E. 80.)
52. Multiply the sum of 74835 and 9085 by the difference between 9075 and 8093, and divide the product by the sum of 13 and 71. (* E. 78.)
53. Multiply the sixth part of the sum of 8064 and 7902 by seven times their difference, and divide the result by 14. Express the answer in words. (E. 79.)
54. From 34856 subtract the product of 763 and 41, and divide the remainder by 397. (S. 85.)
55. Find the sum, difference, product, and quotient of 190165 and 521. (E. 82.)
56. Explain the difference between the *intrinsic* and *local* value of the numerical symbols (figures or digits). What is the use of the symbol 0? Illustrate your answer by the values of the digits in the number 5076. (G. 80.)
57. Subtract 673 from 829, explaining how you get over the difficulty of taking a greater digit from a less. (* E. 76.)
58. What is the reason for carrying or borrowing in subtraction, when the figure above is less than the figure below? (You may illustrate by an example.) (A. 80.)
59. Show that Multiplication is only a short way of finding the sum of a number of the same quantities, and illustrate your remarks in multiplying 450269 by 6. (A. 83.)
60. Show that Division is only a short way of finding the result of a series of subtractions; and illustrate your remarks in dividing 173456 by 34628. (A. 81.)

EXERCISE II

COMPOUND RULES—MONEY.

1. What is the value of Five million halfpence? (S. 80.)
2. Express 4,275,636 farthings in terms of pounds, shillings, and pence. (G.)
3. Reduce £29, 10s. 0½d. and 1373 half-crowns to the same name. (S. 83.)
4. Reduce £8, 17s. 6d. to half-crowns. (G.)
5. Reduce 763 guineas to sixpences, and 23,405 florins to half-crowns. (E.)
6. Reduce 2643 farthings to guineas, 275 florins to half-crowns, and 943 half-guineas to crowns. (E.)
7. How many guineas are equivalent to 142 half-crowns with 69 fourpenny pieces? (G.)
8. How many Eightpence-halfpenny loaves can I buy for Twelve pounds eighteen shillings and sixpence-halfpenny? (S. 80.)
9. How many articles, which cost £2, 10s. 3¼d. each, can be bought for £40, 5s.? (E.)
10. If a yard of cloth costs 14s. 7d., how many can be purchased for £153, 14s. 7d.? (E. 78.)
11. By what must £4, 18s. 9½d. be multiplied to produce £2771, 2s. 1½d.? (* E. 74.)
12. Add together £437, 9s. 1½d., £835, 14s. 11½d., £1184, 16s. 2d., £57, 7s. 5¾d., £1287, 19s. 11½d., £768, 10s. 4½d., £89, 11s. 8½d., £2345, 6s. 7d., £73, 15s. 10½d., £987, 6s. 4¾d., £63, 14s. 8¾d., £1705, 13s. 4d. (S. 85.)
13. Add together £473, 14s. 5½d., £1835, 6s. 10d., £68, 12s. 5d., £977, 18s. 9¼d., £7654, 2s. 7½d., £543, 17s. 11¼d., £835, 5s. 2½d., £4567, 8s. 9d., £24, 16s. 8½d., £2076, 15s. 3½d., £503, 10s. 6½d., £87, 11s. 4¾d., £9, 17s. 11d., £8765, 4s. 3½d. (* S. 86.)

14. A man has the following debts to pay: To A, £12, 6s. $4\frac{1}{2}$ d.; to B, £13, 5s. $6\frac{3}{4}$ d.; to C, £24, 4s. $8\frac{1}{4}$ d.; to D, £32, 6s. 8d. What will he have left out of a hundred-pound bank-note? (G.)
15. Add together 212 guineas, 95 crowns, 81 half-crowns, and 124 fourpenny pieces, expressing the result in pounds, shillings, pence. (E. 84.)
16. A cash-box contains 89 sovereigns, 35 half-sovereigns, 19 half-crowns, 25 florins, 31 shillings, and 15 sixpences; find the sum of all these coins in pence. (S. 84.)
17. Multiply £28, 17s. $9\frac{1}{4}$ d. by 149. (*E. 79.)
18. Multiply £47, 19s. $8\frac{3}{4}$ d. by 276. (G. 82.)
19. Find the value of Three thousand seven hundred and sixty-five yards of calico at $5\frac{3}{4}$ d. per yard. (S. 81.)
20. Multiply Twenty-nine pounds nineteen shillings and tenpence three-farthings by One hundred and ninety-two. (S. 82.)
21. Find the value of 3126 articles at £4, 17s. $9\frac{3}{4}$ d. each. (S. 82.)
22. Find by any method the value of 139 articles at £17, 8s. $5\frac{1}{4}$ d. each. (A. 80.)
23. What is the value of 721 articles at 14s. $8\frac{1}{2}$ d. each? (G. 83.)
24. Find by any method the value of 879 articles at £9, 9s. $11\frac{1}{2}$ d. each. (A. 82.)
25. Find the price of 7893 articles at 6s. $7\frac{1}{2}$ d. each. (G. 85.)
26. Find by any method the value of 975 articles at £7, 6s. $7\frac{1}{2}$ d. each. (A. 83.)
27. A dividend of £3, 7s. $5\frac{1}{2}$ d. per share is declared in a company of 793 shareholders. Required the sum divided. (E.)
28. Find by any method the value of 547 articles at £2, 13s. $10\frac{1}{2}$ d. each. (A. 84.)
29. Find the difference between 17 times £141, 8s. $10\frac{1}{2}$ d. and 34 times £70, 14s. $5\frac{3}{4}$ d. (E. 75.)

30. What is the rent of $237\frac{1}{2}$ acres of land at £1, 3s. 6d. per acre? (G. 78.)
31. Find the value of $206\frac{1}{3}$ articles at £8, 17s. $10\frac{1}{2}$ d. each. (A. 81.)
32. Find the difference in value between 24,960 things at $8\frac{1}{4}$ d. and $36\frac{1}{2}$ things at £3, 10s. 8d. (E.)
33. Divide £166, 19s. $1\frac{1}{2}$ d. equally among 37 men. (E.)
34. Divide £139, 12s. $10\frac{1}{2}$ d. by 169. (E.)
35. Divide £119, 232, 1s. $10\frac{1}{2}$ d. by 674. (* S. 86.)
36. Divide £9366, 0s. $11\frac{1}{4}$ d. by 135, and express the result in farthings. (S. 79.)
37. Divide £567, 6s. 9d. by 81, and multiply the result by 63. (E. 81.)
38. Multiply £634, 15s. $6\frac{1}{4}$ d. by 45; and divide £28,565 by 45. (S. 78.)
39. Multiply £1012, 19s. $9\frac{1}{2}$ d. by 21; and divide £6850, 1s. $2\frac{1}{4}$ d. by 9. (S. 81.)
40. Multiply £5, 18s. $6\frac{1}{2}$ d. by 329; and divide £1276, 5s. by 179. (G. 81.)
41. Multiply £85, 4s. $6\frac{1}{4}$ d. by 132, and divide the product by 78. (S. 83.)
42. Multiply £18, 15s. $4\frac{1}{2}$ d. by 198, and divide the product by 375. (G. 84.)
43. Multiply £76, 3s. $10\frac{1}{2}$ d. by 137; and divide £7197, 12s. $4\frac{1}{2}$ d. by 183. (G. 85.)
44. Multiply £14, 34. $8\frac{1}{4}$ d. by 347; and divide £462, 12s. $9\frac{1}{4}$ d. by 83. (S. 85.)
45. £142, 5s. is to be divided equally among 16 persons; find the share of each. (G. 78.)
46. A sum of £182, 5s. $6\frac{1}{2}$ d. is to be divided equally among 29 persons. Find how much each person gets. Prove your answer by multiplication. (G. 81.)
47. From 261 times £35, 4s. 2d. take £9089, 5s., and divide the remainder by 89. (E. 73.)

48. What was wheat per quarter when 23 quarters cost £56, 19s. 5½d. ? (S. 81.)
49. Fifty-eight shares in a mine are divided among 7 persons. If the shares bring £39, 13s. 4d. each, how much will each person receive ? (E.)
50. A man has an annual income of £695, 15s. 7½d. How much can he spend a day in an ordinary year ? How much in a leap-year ? (G.)
51. Divide £1474, 17s. 6d. by 13½. (E. 71.)
52. Divide £9075, 11s. 2d. by 11¾. (E.)
53. What will the wages of 25 men amount to in the course of a year at the rate of £1, 15s. each per week ? (S. 80.)
54. Find the value of the wheat crop on 89 acres, when the yield is 31 bushels per acre, and the price of wheat is 6s. 3d. per bushel. (E.)
55. Three thousand workmen strike because an advance of ½d. per hour is not conceded. Find the additional sum that would be required weekly to concede the demand, taking a working day as 9 hours. (E.)
56. Divide £1000 between A and B, so that A may have £1 more than B. (E.)
57. Divide £124 amongst A, B, and C, so that A may have £13 more than B, and B £12 more than C. (E.)
58. Divide £839, 10s. between A, B, and C, giving A £10 more than B, and B £5, 10s. more than C. (* F. 78.)
59. The sum of £582, 16s. has to be divided amongst 30 soldiers and 2 officers—the portion of an officer being 3 times that of a soldier. How much will an officer get ? (E.)
60. A and B together possess £120, A and C £140, and B and C £150. What does each possess ? (E.)

EXERCISE III.

COMPOUND RULES—WEIGHTS AND MEASURES.

1. Reduce 20,367 lb. to tons, and prove your answer by reducing it back again to lb. (G. 81.)
2. Reduce 7 tons 12 cwt. 3 qr. to lb.; and 3 stones 11 lb. 6 oz. to ounces. (G.)
3. Find the value in lb. troy of Four hundred and ninety-seven millions twenty-six thousand and four grains. (* E. 77.)
4. Reduce 234,567 grains to lb. troy. (* S. 86.)
5. How many ounces troy are together equal to one cwt.? (E.)
6. Reduce 14,728 grains to ounces avoirdupois. (E. 75.)
7. Reduce 1457 lb. troy to lb. avoird.; given 1 lb. avoird. = 7000 grains. (E. 71.)
8. Reduce 4 miles 3 fur. 27 po. 4 yd. 1 ft. to inches. (A. 84.)
9. Reduce 3 miles 1 fur. 3 po. 2 yd. to inches. (A. 85.)
10. Reduce 3 miles 5 fur. 17 po. 4 yd. 1 ft. 3 in. to inches. (* S. 86.)
11. How many inches are there in 4 miles 3 fur. 36 po. 3 yd. 2 ft. 6 in.? (G. 82.)
12. Reduce a hundred million inches to miles. (E.)
13. Reduce 893,475 inches to miles. (* E. 78.)
14. How many miles are in 173,679 inches? (G. 84.)
15. Express 132,144 inches in miles, yards, feet. (E. 73.)
16. Reduce 5 ac. 3 ro. 39 po. 27 sq. yd. to sq. ft. (A. 82.)
17. How many square inches are in 2 ac. 3 ro. 10 po. 12 sq. yd. 6 sq. ft.? (G. 78.)
18. Reduce 7,593,648 square feet to acres. (E.)
19. Reduce 78,467 English ells to yards; and find their value at 2d. for 3 yards. (E. 74.)

20. How many seconds were there in the year 1876?
(A. 83.)
21. A mean solar year consists of 365 days 5 hours 48 minutes 57 seconds. How many seconds are there in 57 years?
(G. 83.)
22. How many days are there in Eighty-six thousand four hundred seconds?
(S. 81.)
23. If a year of 365 days 5 hours 48 minutes 48 seconds be divided into 415 parts, how many seconds are there in each part?
(S. 78.)
24. How many weeks, days, &c. are there in as many seconds as there are ounces in sixty tons? (E.)
25. In how many days would a body move from the earth to the moon at the rate of 31 miles per hour, taking the distance to be 237,615 miles? (G.)
26. Find how many inches are in 3 miles 5 fur. 36 po. 3 yd. 2 ft.; how many sq. ft. are in 8 ac. 3 ro. 12 sq. po. 8 sq. yd.; and how many lb. are in 13 tons 18 cwt. 3 qr.
(G. 80.)
27. I find that 228 pages of a book give a thickness of half an inch. How many pages would give a thickness of a mile?
(S. 78.)
28. A certain nobleman is said to be worth £5 per minute. What is his annual income? (* E. 83.)
29. Into how many portions must 2 tons 2 cwt. 3 qr. 12 lb. be divided, in order that each may contain 1 cwt. 0 qr. 8 lb.?
(E.)
30. How many parcels, each containing 2 lb. 4 oz., can be made up from 4 cwt. 3 qr. $1\frac{1}{4}$ lb. of sugar? (G. 83.)
31. The standard weight of a sovereign is $123\frac{1}{2}$ troy grains. How many sovereigns can be coined out of 8 cwt. 3 qr. 19 lb. of gold of standard fineness? The lb. avoird. is 7000 grs.
(G. 78.)
32. Find how many times a length of two yards and three-quarters is contained in a mile.
(S. 81.)
33. A cart-wheel, 13 ft. $2\frac{3}{4}$ inches in circumference, travels 24 miles 264 yd. How often does it turn round on the journey?
(* G. 84.)

34. Add together 5 tons, 50 cwt., 500 qr., 5000 lb., and 50,000 ounces. (E.)

35. How many square feet are in *four* fields of which
 the first contains 3 ac. 3 ro. 15 perches 4 sq. yd.
 the second " 4 " 2 " 29 " 17 "
 the third " 2 " 1 " 24 " 3 "
 and the fourth " 5 " 0 " 37 " 18 " ?
 (G. 79.)

36. Add together 13 ac. 2 ro. 27 po. 20 sq. yd., 5 ac. 3 ro. 18 po. 13 sq. yd., 6 ac. 1 ro. 9 po. $11\frac{1}{2}$ sq. yd., and 3 ac. 3 ro. 16 po. 16 sq. yd., and find how many square feet are in the sum. (G. 81.)

37. Add together the following quantities :

17 ac. 2 ro. 36 po. $27\frac{3}{4}$ sq. yd.

25 " 3 " 17 " 11 "

39 " 1 " 18 " 16 "

26 " 2 " 23 " $17\frac{1}{4}$ "

31 " 0 " 33 " 29 "

and find how many square yards are in the sum.

(G. 84.)

38. Which is the larger, 5 furlongs, or 4 fur. 39 po. 5 yd. 2 ft. 6 in. ? And by how much ? (A. 81.)

39. Subtract 10 weeks 4 days 11 hours 7 minutes and 20 seconds, from 12 weeks 3 days 15 hours and 17 seconds. (A. 80.)

40. Multiply 37 tons 4 cwt. 3 qr. 7 lb. by 83. (*S. 86.)

41. Multiply 14 tons 17 cwt. 2 qr. 18 lb. 11 oz. by $12\frac{1}{2}$. (E. 74.)

42. Multiply 9 ac. 3 ro. 22 po. 4 sq. yd. by 239. (G. 83.)

43. Multiply 37 ac. 3 ro. 19 po. 28 sq. yd. 4 sq. ft. 103 sq. in. by 8. (S. 84.)

44. Find the difference between 37 lots of 2 qr. 17 lb. 14 oz., and 65 lots of 1 qr. 14 lb. (E.)

45. Divide 275 tons 14 cwt. 1 qr. 5 lb. by 127. (G. 82.)

46. Divide 30 tons 17 cwt. 1 qr. 24 lb. 3 oz. by 83. (*E. 79.)

47. Divide 487 tons 13 cwt. 1 qr. 25 lb. 14 oz. by 9. (S. 84.)

48. Divide 327 miles 3 fur. 27 po. 3 yd. 1 ft. 1 in. by 89. (G. 81.)
49. Divide 198 ac. 3 ro. 16 perches 3 sq. yd. 72 sq. in. by 187. (S. 82.)
50. Three fields, containing respectively 3 ac. 2 ro. 24 po. 25 sq. yd., 2 ac. 3 ro. 12 po. $18\frac{1}{2}$ sq. yd., and 4 ac. 1 ro. 20 po. 17 sq. yd., are to be divided equally among three persons. Find the quantity each person receives. (G. 82.)
51. Multiply 3 lb. 8 oz. 18 dwt. 8 gr. by 35; and divide 325 miles 7 fur. 25 po. 3 yd. 2 ft. 3 in. by 7. (S. 85.)
52. Thirty-three posts, placed at equal distances, extend a mile. How far apart are the posts? (S. 82.)
53. Multiply 9 cwt. 3 qr. 24 lb. by 249, by compound multiplication, and find the value of the result at £4, 15s. per cwt. (G. 81.)
54. A farmer rents 6 fields, each containing 7 ac. 3 ro. 35 po.; 5 fields, each containing 3 ac. 2 ro. 17 po.; and 9 fields, each containing 5 ac. 1 ro. 25 po. How much land has he altogether, and what will be his rent at £3, 15s. per acre? (S. 79.)
55. Find the number of inches in 1578 miles 3 fur. 20 po. 5 yd. 1 ft. 9 in. (G.)
56. Find the cost of a telegraph cable of the above length, allowing 5s. 9d. the yard for construction, and £22 the mile for laying. (G.)
57. Find the cost per lb. of a substance of which 3 cwt. 2 qr. 5 lb. cost £529, 6s. 8d. (E.)
58. Find the price per lb. of a substance of which 10 cwt. 3 qr. 24 lb. cost £10,292, 17s. 6d. (E.)
59. Find the cost of a ton of sugar at $\frac{3}{4}$ d. per lb., of an ounce of tea at 5s. 8d. per lb., and of a peck of flour at £3 per quarter. (S. 82.)
60. Explain what is meant by the terms *square inch* and *square foot*. Illustrate your remarks by diagrams, and show from your diagrams that there are 144 square inches in a square foot. (A. 84.)

EXERCISE IV.

VULGAR FRACTIONS.

1. What are prime numbers? When are two numbers relatively prime? Resolve 1250 and 2205 into their prime factors. (* A. 85.)
2. Resolve 10584 into its elementary factors. (E.)
3. What is meant by a common measure of two or more numbers? Give all the common measures of 48, 64, and 80, and their greatest common measure. (* A. 83.)
4. Find the G.C.M. of 441, 504, 1470. (A. 85.)
5. Find the L.C.M. of 252, 360, and 490. (E.)
6. Find the G.C.M. and the L.C.M. of 75, 125, and 1000. (E.)
7. Find the G.C.M. of 19721 and 68635; and the L.C.M. of 18, 24, 26, 30, 39. (E.)
8. Find the G.C.M. of 7543 and 15181; also the L.C.M. of 56126 and 198. (G. 80.)
9. Find the G.C.M. of 1617, 2871, and 4213; and the L.C.M. of the even numbers from 10 to 26 inclusive. (S. 85.)
10. Reduce to their lowest terms $\frac{2573}{1067}$, $\frac{856}{938}$, and $\frac{1859}{3003}$. (E.)
11. Reduce $\frac{3}{8}$, $\frac{5}{12}$, and $\frac{11}{15}$ to equivalent fractions having the least common denominator. (G. 80.)
12. Arrange the following fractions in the ascending order of magnitude:
 $\frac{6}{7}$, $\frac{3}{8}$, $\frac{4}{5}$, $\frac{11}{15}$, $\frac{17}{20}$. (E.)
13. Add together $\frac{1}{3}$, $\frac{3}{8}$, $\frac{4}{9}$, and $\frac{11}{15}$. (G. 78.)
14. What is the sum of $\frac{1}{2} + \frac{5}{21} + \frac{3}{10} + \frac{7}{45} + \frac{5}{18} + \frac{2}{33}$? (* E. 73.)
15. Simplify $\frac{1}{3} + \frac{1}{6} + \frac{2}{9} + \frac{1}{10} + \frac{3}{7} + \frac{1}{14} + \frac{4}{9} + \frac{1}{15}$. (E. 84.)

16. Add together $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$, $\frac{1}{80}$, $\frac{1}{160}$, $\frac{1}{320}$. (E.)
17. Add together and express as a fraction in its lowest terms $\frac{1}{10}$, $\frac{5}{20}$, $\frac{6}{30}$, $\frac{5}{150}$, and $\frac{1}{2}$. (+ E. 73.)
18. Add together $\frac{1}{38}$, $\frac{1}{78}$, $\frac{1}{98}$, and $\frac{11}{200}$, giving the sum in its lowest terms. (+ E. 74.)
19. Reduce $\frac{119}{241}$, $\frac{863}{1331}$, and $\frac{4286}{6429}$ to their lowest terms, and add them together. (E. 85.)
20. Add together $10\frac{5}{8}$, $3\frac{1}{4}$, $\frac{11}{12}$, and $\frac{17}{24}$. (A. 85.)
21. Add together $1\frac{2}{3}$, $2\frac{3}{4}$, $3\frac{4}{5}$, $4\frac{5}{6}$, $5\frac{6}{7}$. (E.)
22. Add together $\frac{1}{2}$, $\frac{1}{3}$ of $\frac{1}{2}$, $\frac{1}{4}$ of $\frac{1}{3}$ of $\frac{1}{2}$, $\frac{1}{5}$ of $\frac{1}{4}$ of $\frac{1}{3}$ of $\frac{1}{2}$, $\frac{1}{6}$ of $\frac{1}{5}$ of $\frac{1}{4}$ of $\frac{1}{3}$ of $\frac{1}{2}$. (E.)
23. Find the value of $\frac{1}{2}$ of $\frac{3}{4}$ + $\frac{3}{5}$ of $\frac{5}{6}$ + $\frac{7}{4}$ of $\frac{9}{14}$ + $\frac{35}{28}$ of $\frac{39}{14}$ + $\frac{31}{21}$ of $\frac{14}{3}$. (E. 85.)
24. Add together $1\frac{2}{3}$ of $1\frac{1}{2}$, $2\frac{2}{3}$ of $3\frac{1}{3}$, and $1\frac{1}{7}$ of $2\frac{5}{7}$. (* E. 71.)
25. Add together $\frac{1}{3}$ of $3\frac{1}{3}$, $\frac{1}{5}$ of $4\frac{1}{5}$, $\frac{1}{7}$ of $4\frac{1}{7}$, and $\frac{1}{8}$ of $1\frac{1}{8}$. (+ E. 71.)
26. Add together $\frac{1}{2}$ of $3\frac{1}{3}$, $\frac{1}{3}$ of $3\frac{1}{2}$, $\frac{1}{4}$ of $3\frac{1}{4}$, and $\frac{1}{5}$ of $3\frac{1}{5}$, expressing the fractional part of the result in its lowest terms. (* E. 74.)
27. Add together $\frac{2}{7}$ of $11\frac{1}{2}$, $\frac{1}{4}$ of $12\frac{1}{4}$, and $\frac{5}{9}$ of $\frac{1}{4}$ of $5\frac{1}{4}$. (* E. 75.)
28. Which is the larger, $\frac{1}{12}$ or $\frac{1}{18}$? and by how much? (A. 80.)
29. Add together $3\frac{2}{3}$, $\frac{5}{8}$, and $\frac{7}{12}$, and from the sum subtract $\frac{2}{3}$ of $3\frac{1}{4}$. (G. 78.)
30. Add together $\frac{2}{5}$, $\frac{5}{8}$, $2\frac{1}{4}$, $1\frac{2}{3}$, and from the sum subtract $\frac{1}{3}$ of $4\frac{5}{8}$. (G. 79.)
31. Add $2\frac{3}{4}$, $5\frac{4}{9}$, $6\frac{7}{15}$, and take $11\frac{1}{18}$ from the result. (* E. 80.)
32. Add together $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, and from their sum take $1\frac{5}{6}$. (G. 80.)
33. Add together $\frac{1}{10}$, $\frac{1}{30}$, and $\frac{1}{15}$, and deduct the sum from $2\frac{1}{30}$. (S. 80.)
34. Add $1\frac{2}{3}$, $\frac{5}{8}$, $\frac{7}{9}$, and $\frac{1}{2}$ of $\frac{3}{2}$, and from the sum subtract $1\frac{1}{4}$. (G. 81.)

35. Add together $1\frac{2}{3}$, $2\frac{3}{4}$, $3\frac{5}{6}$, $4\frac{4}{7}$, and from the sum take $5\frac{7}{8}$. (G. 81.)
36. Add together $5\frac{4}{9}$ + $\frac{3}{8}$ + $\frac{7}{12}$ + $2\frac{5}{24}$, and subtract the sum from $17\frac{2}{9}$. (S. 81.)
37. Add $3\frac{1}{18}$, $8\frac{7}{18}$, $4\frac{5}{12}$, $7\frac{2}{3}$, and $2\frac{1}{2}$. From $\frac{4}{7}$ of $8\frac{2}{3}$ take $\frac{3}{5}$ of $3\frac{3}{4}$. (G. 82.)
38. Add together $4\frac{5}{12}$, $7\frac{2}{9}$, $10\frac{4}{18}$, $17\frac{6}{7}$, and $8\frac{5}{6}$. From $\frac{9}{8}$ of $8\frac{3}{8}$ take $\frac{5}{7}$ of $11\frac{2}{3}$. (G. 83.)
39. Add into one sum $3\frac{4}{5}$, $5\frac{3}{7}$, and $6\frac{2}{4}$. Subtract $\frac{1}{3}$ of $9\frac{7}{8}$ from $\frac{2}{3}$ of $10\frac{5}{8}$. (G. 85.)
40. Add together $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, and state in its lowest terms how far the sum exceeds or falls short of unity. (E.)
41. Express as a single fraction in its lowest terms:
 $\frac{5}{11} + \frac{3}{14} + \frac{5}{21} + \frac{7}{22} - \frac{1}{28} + \frac{2}{33}$. († E. 80.)
42. Add together $\frac{1}{3} + \frac{1}{7} + \frac{1}{33} + \frac{1}{4} - \frac{1}{1617}$. (* E. 82.)
43. Find the value of $\frac{3}{4} - \frac{34}{100} + \frac{9}{25} - \frac{4}{5} + \frac{5}{16} - \frac{27}{80}$. († S. 82.)
44. Reduce to a single fraction:
 $1\frac{1}{2} + 5\frac{3}{4} - 6\frac{2}{8} + 8\frac{5}{8} - 9\frac{3}{8}$. (S. 78.)
45. Reduce to its simplest form:
 $8\frac{5}{9} - 5\frac{4}{18} + 7\frac{1}{3} - \frac{1}{30}$. (E.)
46. Multiply together $9\frac{1}{2}$, $3\frac{1}{3}$, $5\frac{5}{6}$, $2\frac{2}{7}$, $1\frac{3}{8}$. (G. 81.)
47. Find (1) the sum of $\frac{2}{3} + \frac{1}{6} + \frac{5}{6} + \frac{1}{12}$; (2) the product of $\frac{7}{18} \times \frac{4}{9} \times \frac{15}{8} \times \frac{36}{21}$. (E. 81.)
48. Simplify $\frac{1}{7} - \frac{1}{9} - \frac{1}{11} \times \frac{1}{13}$, and multiply the result by $\frac{9}{22}$. (E.)
49. Simplify $5\frac{1}{8} \times 2\frac{2}{18} \times \frac{10}{21} \div \frac{8}{15}$. (G.)
50. Multiply together 6, $\frac{3}{4}$, $\frac{5}{6}$, and $1\frac{1}{7}$, and divide the product by $\frac{9}{14}$. (G. 78.)
51. Multiply together $3\frac{1}{6}$, $5\frac{5}{6}$, $1\frac{1}{3}$, and $2\frac{5}{6}$, and divide the product by $4\frac{7}{8}$. (G. 79.)
52. Multiply together $\frac{7}{8}$, $\frac{4}{9}$, $2\frac{5}{7}$, and divide the product by $2\frac{2}{3}$. (G. 80.)

53. Multiply together $\frac{2}{3}$, $\frac{3}{5}$, $\frac{5}{8}$, $3\frac{2}{7}$; and divide $1\frac{1}{2}$ of $\frac{3}{4}$ by $\frac{2}{3}$ of $\frac{1}{8}$. (G. 81.)
54. Multiply $8\frac{4}{5}$ by $6\frac{2}{3}$. Divide $4\frac{1}{2}$ by $3\frac{1}{4}$. (G. 82.)
55. Multiply $\frac{3}{5}$ of $37\frac{7}{8}$ by $\frac{4}{7}$ of $16\frac{1}{16}$. Divide $53\frac{3}{16}$ by $\frac{3}{4}$ of $19\frac{5}{8}$. (G. 83.)
56. Add together $4\frac{1}{3}$, $12\frac{3}{4}$, $5\frac{5}{8}$, and $9\frac{7}{12}$. Divide $\frac{2}{3}$ of $25\frac{1}{4}$ by $4\frac{5}{8}$. (G. 84.)
57. Multiply together $3\frac{4}{5}$, $5\frac{2}{7}$, and $6\frac{3}{4}$; and divide $118\frac{2}{7}$ by $15\frac{1}{4}$. (G. 85.)
58. Multiply $\frac{2}{3}$ by $\frac{4}{5}$, and divide the product by the quotient of $\frac{2}{7}$ by $\frac{8}{9}$. (E.)
59. Divide the difference between $3\frac{2}{5}$ and $1\frac{1}{2}$ by the product of $3\frac{1}{8}$ and $1\frac{1}{4}$. (E.)
60. How many times is two and two-thirds contained in ten and one-third?
By how much does the sum of $1\frac{1}{28}$ and $\frac{9}{18}$ exceed the difference? (S. 80.)
61. Simplify (1) $\frac{5}{7} - 1\frac{1}{3} + 2\frac{6}{8} + \frac{4}{7}$ of $2\frac{1}{2} - 2\frac{2}{7}$.
(2) $819\frac{13}{567} - 815\frac{7}{187}$. (* E. 78.)
62. Simplify $\frac{1}{4} + \frac{1}{28} + 1\frac{1}{56}$; and $\frac{1}{3} - \frac{1}{28} + 1\frac{1}{28}$. (* E. 83.)
63. Find the value of

$$1 - \frac{1}{2} + \frac{1}{2 \times 3} - 2 \times \frac{1}{3 \times 4} + 2 \times \frac{1}{3 \times 4 \times 5}$$
(E.)
64. Find the difference between $\frac{4}{7}$ of $\frac{3}{5}$ of $4140\frac{1}{2}$ and $\frac{2}{3}$ of $\frac{5}{11}$ of 1089 . Divide the result by $\frac{2}{5}$ of $\frac{1}{11}$ of $504\frac{1}{6}$. (E.)
65. Express as single fractions in their lowest terms:
 (1) $\frac{1}{2} + \frac{1}{7} + \frac{7}{8} + \frac{3}{10} + \frac{1}{12} + \frac{1}{20} + \frac{3}{28}$.
 (2) $\frac{27\frac{1}{4} - 21\frac{5}{8}}{3\frac{1}{3} - 2\frac{7}{8}}$. (E.)
66. Simplify the following expressions:
 (1) $8\frac{1}{2} + 9\frac{2}{3} + 10\frac{3}{4} + 11\frac{4}{5}$.
 (2) $\frac{1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4}}{1 + \frac{1}{2} - \frac{1}{3} - \frac{1}{4}}$. (E. 80.)

67. Simplify $\frac{1\frac{1}{2} + 3\frac{4}{5} + 5\frac{1}{12} + 7\frac{5}{18} + 9\frac{1}{36}}{3\frac{11}{12}}$. . (G.)

68. Simplify $\frac{1\frac{1}{2} + 1\frac{5}{12} + \frac{7}{24} + \frac{11}{60} - 2}{10\frac{9}{11}}$. (E. 83.)

69. Simplify $\frac{\frac{1}{2} - \frac{2}{3} + \frac{3}{4}}{\frac{1}{3} - \frac{2}{5} + \frac{5}{7}}$. (E.)

70. Simplify $\frac{\frac{10}{3} + \frac{5}{6} - \frac{20}{21}}{\frac{5}{6} - \frac{4}{3}}$. (S. 83.)

71. Simplify $\frac{\frac{7}{25} + \frac{5}{4} - \frac{1}{8}}{\frac{3}{4} + \frac{4}{75} - \frac{1}{6}}$. (G.)

72. Reduce to their lowest terms:

(1) $\frac{8025}{72225}$.

(2) $\frac{\frac{5}{4} + \frac{18}{16} + \frac{13}{32} + \frac{7}{480}}{\frac{11}{24} - \frac{7}{40}}$. (E. 82.)

73. Simplify $\frac{2\frac{2}{3} \text{ of } 3\frac{3}{4}}{2\frac{2}{3} + 3\frac{3}{4}}$. (S. 84.)

74. Find the value of $\frac{3}{4}$ of $\frac{5}{7} + \frac{2}{3}$ of $\frac{4}{9} - \frac{5}{6}$ of $\frac{1}{2}$, and divide the result by $\frac{5}{16}$. (S. 82.)

75. Simplify $\frac{\frac{1}{2} \text{ of } \frac{3}{4} + \frac{2}{3} \text{ of } \frac{9}{16}}{\frac{1}{4} \text{ of } \frac{9}{2} + \frac{1}{2} \text{ of } \frac{10}{25}}$; and $\frac{2057}{22200}$. (E. 84.)

76. Simplify $\frac{\frac{7}{10} \text{ of } 3\frac{1}{8}}{\frac{1}{9} + \frac{1}{3} \text{ of } \frac{1}{9}} \div \frac{5\frac{1}{4}}{4\frac{1}{8}}$. (E.)

77. Reduce to their simplest forms:

$\frac{20530}{28742}$; and $\frac{\frac{43}{4} + \frac{12}{5}}{16\frac{2}{3} - 6\frac{3}{4}} + \frac{3\frac{2}{3}}{10\frac{1}{2}}$. (E.)

78. Simplify $\frac{6}{7}$ of $(1\frac{5}{8} - \frac{1}{3}) \div 4\frac{3}{7} - \frac{9}{11}$ of $\frac{\frac{7}{8} - \frac{3}{16}}{\frac{11}{3} + \frac{11}{12}}$. (A. 83.)

79. Simplify $\frac{1\frac{4}{7} - \frac{2}{3}}{2\frac{1}{2} + 1\frac{3}{4}} \times (1 - \frac{4}{15}) + \frac{5}{6}$ of $\frac{4}{5} - \frac{1}{6}$. (A. 84.)

80. Simplify $\frac{(1\frac{1}{2} + \frac{3}{5} + 2\frac{1}{4}) \times (2\frac{1}{7} + \frac{5}{14} + 3\frac{1}{2})}{.8 + \frac{1}{7} \times 1\frac{2}{5} + \frac{2}{7} + \frac{1}{4}}$. (S. 79.)

$$81. \text{ Simplify } \frac{8\frac{3}{4} - 7\frac{3}{4} + 5\frac{2}{3} - 4\frac{1}{2}}{13 - 11\frac{9}{10} + 10\frac{7}{9} - 9\frac{17}{20}} \times 1\frac{12}{131} \div \frac{36}{365}. \quad (* S. 85.)$$

$$82. \text{ Simplify } \frac{\frac{3}{7} - \frac{5}{8} \times \frac{3}{8}}{2\frac{1}{2} \div 1\frac{1}{3} + \frac{2}{5}} \times 4\frac{1}{2} - \frac{4}{5} \text{ of } (\frac{5}{8} - \frac{15}{32}). \quad (* A. 84.)$$

$$83. \text{ Simplify } \frac{\frac{3}{11} \text{ of } 3\frac{1}{7} - \frac{3}{14}}{\frac{2}{3} + \frac{1}{3} - \frac{5}{7}} \div 67\frac{1}{2} - \frac{1}{2}. \quad (A. 82.)$$

$$84. \text{ Simplify (1) } \frac{18}{\frac{3}{4} \text{ of } 4\frac{3}{7}} \div 17\frac{1}{2}; (2) \frac{\frac{2}{3} + \frac{4}{5} \text{ of } \frac{5}{6} - \frac{8}{12}}{1 + \frac{2}{3} \times \frac{5}{7} - \frac{5}{6}}. \quad (S. 85.)$$

$$85. \text{ Divide 2 by the sum of } 2\frac{2}{3}, \frac{4}{5}, \text{ and } 4; \text{ add } 1\frac{2}{3} - \frac{7}{5} \text{ to the quotient, and multiply the result by the difference between } 5\frac{1}{5} \text{ and } 4\frac{1}{2}. \quad (\dagger S. 81.)$$

$$86. \text{ Simplify } \frac{\frac{7}{2} \text{ of } \frac{5}{3}}{1 + \frac{2}{3} \text{ of } \frac{1}{4}} - \frac{\frac{1}{8} + \frac{1}{4}}{\frac{5}{8}}. \quad (* E. 79.)$$

$$8 - (\frac{5}{4} \text{ of } 1\frac{1}{2}) \div 1\frac{9}{14}$$

$$87. \text{ Simplify } \left(\frac{\frac{5}{3} \text{ of } 5\frac{1}{5} - \frac{5}{8} + \frac{6}{7}}{\frac{3}{7} \text{ of } 1\frac{3}{9} + 1\frac{3}{4}} \right) \times 4\frac{3}{10} - \frac{2}{3}. \quad (* A. 81.)$$

$$88. \text{ Simplify (1) } \frac{2}{3} + \frac{1}{7} + \frac{35}{28} + \frac{4}{21} - \frac{1}{8} - \frac{28}{8}$$

$$(2) \frac{(\frac{3}{5} + \frac{1}{4}) \times (\frac{3}{8} - \frac{1}{4})}{\frac{1}{10} \left\{ \frac{1}{2} - 2(\frac{1}{3} - \frac{1}{6}) \div \frac{\frac{3}{4} + \frac{7}{28}}{\frac{1}{2} + \frac{1}{10} + \frac{14}{35}} \right\}}$$

$$(S. 79.)$$

$$89. \text{ Simplify } \frac{(5\frac{1}{2} \text{ of } \frac{2}{9} \text{ of } \frac{4}{7}) \div (1 \div \frac{1}{5} + \frac{1}{2})}{1 - \frac{3}{14} \text{ of } (\frac{1}{2} + \frac{1}{2} \text{ of } \frac{\frac{1}{20}}{\frac{1}{7} \times 1\frac{1}{20}})} \quad (\dagger S. 82.)$$

$$90. \text{ Multiply the difference between } \frac{4095}{13842} \text{ and } \frac{46431}{161631} \text{ by the sum of } 4\frac{7}{8} \text{ and } 1\frac{3}{8}, \text{ and multiply the product by the difference between } 10\frac{2}{5} \text{ and } 5\frac{2}{3}. \quad (* S. 86.)$$

$$91. \text{ Show that the value of a fraction is not altered when its numerator and denominator are multiplied by the same number. Illustrate your remarks by an example.} \quad (A. 82.)$$

92. What is the half of a third of £1, 15s. 9d? (S. 81.)
93. Find the value of $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{5}{17}$ of $4\frac{1}{3}$ of 235 guineas.
(* E. 76.)
94. Find the value of
£17, 2s. 6d. $\div 11\frac{5}{12}$ + £1, 16s. 9d. $\div \frac{63}{893}$. (E.)
95. Add together $\frac{1}{8}$ of $\frac{4}{5}$ of 5s. 5d., $\frac{3}{5}$ of $\frac{10}{18}$ of 4s. 2d., and
 $\frac{1}{3}$ of $\frac{2}{7}$ of 2s. 1d. (S. 80.)
96. Find the value of $2\frac{1}{7}$ of £1, 9s. + $\frac{3}{14}$ of 18s. 2d.
 $\frac{10}{21}$ of $4\frac{1}{2}$ d. (S. 84.)
97. Find the value of $\frac{3}{4}$ of $\frac{5}{8}$ of £1 + $\frac{2}{3}$ of $\frac{5}{9}$ of 2s. 6d.
+ $\frac{3}{4}$ of $10\frac{1}{2}$ d. (S. 85.)
98. Calculate $\frac{2\frac{1}{4} - \frac{2}{3} \text{ of } 1\frac{5}{6}}{\frac{1}{5} \text{ of } 3\frac{1}{3} + \frac{1}{3}\frac{3}{8}}$ of 4s. 9d. (A. 85.)
99. Find the value of $\left(\frac{2\frac{1}{4} - \frac{2}{3} \text{ of } \frac{11}{6}}{\frac{1}{5} \times \frac{10}{3} + \frac{1}{2}\frac{3}{8}} - \frac{1}{2\frac{1}{2}}\right) \div \frac{1}{1\frac{2}{3}}$ of £1.
(* A. 80.)
100. Reduce $78\frac{1}{3}$ guineas to half-crowns; and $3\frac{1}{8}\frac{7}{4}$ tons
to ounces. (E.)
101. Reduce $967\frac{11}{12}$ guineas to pounds, shillings, and
pence. (G.)
102. Find the difference between the seventeenth part of
200 crowns and the seventh part of 19 guineas.
(E.)
103. Reduce 6s. 4d. to the fraction of a guinea, and
2 cwt. 3 qr. to the fraction of a ton. (G. 81.)
104. Reduce 4 ac. 3 ro. 25 po. to the fraction of 25 acres.
(* E. 77.)
105. What fraction of 1 ton 1 qr. 20 lb. is 6 cwt.
2 qr.? (G. 85.)
106. What fraction of £5, 2s. 3d. is £1, 7s. 9d.? What is
3 ro. 10 po. of an acre? and what 2 qr. 7 lb. of
a cwt.? (G. 81.)
107. Find what fraction £1, 3s. $2\frac{1}{2}$ d. is of £2, 17s. $6\frac{1}{2}$ d.;
and what fraction 1 mile 102 yd. 2 ft. is of 2 miles
20 yd. $1\frac{1}{2}$ ft. [Express the results as vulgar
fractions in their simplest forms.] (E. 85.)

108. What fraction of $\frac{3}{7}$ of $\frac{5}{18}$ of £1, 17s. 6d. is $\frac{11}{18}$ of $\frac{5}{18}$ of 13s. 4d. ? (* E. 80.)
109. Reduce 11s. 4 $\frac{1}{4}$ d. to the fraction of 18s. 7d., and divide the result by $\frac{11}{10}$. (* E. 74.)
110. What fraction of $\frac{8}{15}$ of a crown is $\frac{1}{3}$ of a guinea? and what proportion does the difference of the two bear to their sum? (E. 78.)
111. What part of 3s. 4d. is
 $\frac{1}{7}$ of $\frac{21}{4} - \frac{2}{3}$ of $\frac{1}{8}$ of $\frac{2}{11}$ of a guinea? (E.)
112. Add together $\frac{1}{2}$ of a guinea, $\frac{1}{4}$ of a pound, and $\frac{1}{8}$ of a crown.
 What fraction of £9, 10s. 9d. is £3s. 8s. 1 $\frac{1}{2}$ d. ? (G. 84.)
113. Reduce the following fractional expressions to their simplest form :
 $\frac{\frac{1}{2} + \frac{1}{3} + \frac{1}{4}}{\frac{1}{2} + \frac{1}{4} + \frac{1}{8}}$; and $\frac{528 \text{ tons } 13 \text{ cwt. } 3 \text{ qr. } 27 \text{ lb. } 1 \text{ oz.}}{674 \text{ tons } 6 \text{ cwt. } 1 \text{ qr. } 2 \text{ lb. } 1 \text{ oz.}}$.
 (E. 79.)
114. A cistern can be filled by one pipe in 3 hours and emptied by another in 5 hours; if they are both kept open, how long will the cistern be in filling? (E.)
115. A can do a piece of work in 6 hours, and B in 8 hours; in what time will they do it working together? (E.)
116. A person's expenses amount to $\frac{2}{3}$ of his income; his taxes amount to $\frac{1}{12}$ of his income, and he saves £150 yearly. Find his income. (E.)
117. A post is $\frac{2}{9}$ of its length in the ground, $\frac{2}{9}$ in the water, and 22 feet above the water. What is its length? (E. 82.)
118. The united value of $\frac{2}{3}$ and $\frac{2}{3}$ of a sum of money is £133. What is the sum? (E.)
119. After giving away $\frac{1}{3}$ of his income in charity, and paying $\frac{1}{12}$ in taxes, a person has £500 left. What is his gross income? (E. 78.)

120. A traveller from Edinburgh to Glasgow has gone $\frac{1}{4}$ of the distance. On walking 29 miles farther, he has only $\frac{1}{8}$ of the distance left. Find the whole distance. (G.)

EXERCISE V.

DECIMAL FRACTIONS.

1. Reduce $\frac{4}{5}$, $\frac{5}{8}$, $\frac{3}{4}$, and $\frac{4}{15}$ to decimal fractions. (G. 81.)
2. Find the decimal value of the following fractions :
 $\frac{123}{1000}$ and $\frac{90}{21}$. (E. 79.)
3. Reduce $\frac{3}{5}$, $\frac{2}{5}$, and $\frac{1}{5}$ to decimal fractions. (E. 85.)
4. If $\frac{1}{1250}$ and $\frac{1}{2500}$ be converted into decimal fractions, will they terminate or recur? Why? (* A. 85.)
5. Express .0325 as a vulgar fraction. To what decimal fraction is two per cent. equivalent? (A. 80.)
6. Reduce .368, .275, .416, and .3653 to vulgar fractions. (G. 81.)
7. Express as vulgar fractions .002916 and .0392. († E. 76.)
8. Reduce $\frac{5}{8}$, $\frac{2}{7}$, $\frac{7}{9}$ to decimals, and .45, .36, and .827 to vulgar fractions. (G. 78.)
9. Express as decimals $\frac{11}{100}$ and $\frac{4}{5}$. Convert 31.43787 into a vulgar fraction. (* S. 78.)
10. Reduce $\frac{17}{1000}$ to a decimal, and .0675 to a vulgar fraction. (* S. 81.)
11. Express as decimals $\frac{3}{5}$ and $\frac{6}{7}$, and as vulgar fractions in their simplest form .35625, .63, and 1.54. (G.)
12. Express $\frac{22}{7}$ and $\frac{55}{13}$ as decimal fractions, and .123 and .01234 as vulgar fractions. (E.)
13. Turn .0375 into a vulgar fraction, and show the connection between this and the fractions equivalent to the 3, the 7, and the 5. (A. 85.)
14. Add 387.4, 12.432, .376, and .0642. (G. 78.)

15. Add together $3.\dot{7}$, $4.\dot{0}\dot{5}$, and $21.1\dot{5}\dot{3}$. (G.)
16. Find the sum of $6.2\dot{7}$, $8.9\dot{2}\dot{5}$, and $6.2\dot{8}$. (G. 79.)
17. Add together $231.4\dot{8}$, $9.7\dot{5}$, $18.8\dot{3}$, $128.9\dot{6}$. (G. 81.)
18. Add $.7 + .\dot{0}\dot{7} + .\dot{0}\dot{7}$, expressing the result as a vulgar fraction in its lowest terms. (E.)
19. Find correct to six decimal places :
 $15.7\dot{0}\dot{9} + 9.12\dot{3}4\dot{5} - 12.01\dot{3} + 17.\dot{1}4285\dot{7} - 7.001\dot{6}\dot{3}$.
20. Find the difference, expressed as a decimal fraction, between 3.1416 and $\frac{22}{7}$, also between 3.1416 and $\frac{355}{113}$. (E.)
21. Add together 10.01 , 1.001 , and 101.1 , and multiply the result by $.101$. (E. 85.)
22. Reduce $\frac{3}{80}$ and $\frac{7}{200}$ to decimals, and multiply the decimals together. (E. 84.)
23. Convert into decimals $\frac{100}{64}$ and $\frac{44}{15625}$. Multiply them together. (* G. 84.)
24. Find the cube of $.15$, and give the reason for the placing of the decimal point—the reason, not the rule. (E.)
25. Multiply 31.06 by $.006$, and convert the result into a vulgar fraction in its lowest terms. (E.)
26. Find the continued product of 123 , 45.6 , and $.00789$. (E.)
27. Show that $.2$ multiplied by $.3$ is equal to $.0\dot{7}\dot{4}$. (E.)
28. Find the result of multiplying $1.85714\dot{2}$ and $.53846\dot{1}$. (* G. 85.)
29. Multiply $.0265$ by 2.5 ; find the excess of the product over $.0625$, and express your result as a vulgar fraction in its lowest terms. (A. 81.)
30. What is a decimal fraction? How do you determine where to place the point in division of decimals?
 Multiply 21.025 by 3.02 , and divide 67.893 by $.83201$ correct to five decimal places. (* S. 80.)
31. Divide $.14425$ by 6714 . Find the value of $.841\dot{3}$. (* S. 82.)

32. Find the value of $.53\dot{1}5\dot{3}$, and divide 5.329 by 73000 . († S. 82.)
33. Divide $.059$ by 1.059 to four decimal places. (E.)
34. Express as a decimal fraction $\frac{3.2}{781.25}$. (E.)
35. Define the *reciprocal* of a number. Find the reciprocal of 1884 to four significant figures. (E.)
36. Find the reciprocal of 98.1 to five places of decimals. (E.)
37. A metre contains 3.2808992 feet. How many metres are there in 20886852 feet? (E. 81.)
38. Explain why in dividing one decimal by another we may, without altering the result, shift the decimal point an equal number of places to the right or to the left in both.
- Divide 318.923 by 3229.6 as far as five places of decimals. (A. 85.)
39. Find (1) the product of $101.5 \times 1.015 \times .01015$;
(2) the quotient of $2.86 \div .013$. (E. 80.)
40. Multiply together 2.005 , $.5$, and $.1$, and divide the product by $.025$. (E.)
41. Multiply and divide 36033.63 by $.00789$. (E. 83.)
42. Multiply 3.5 by $.8$; and divide 79.1 by $.125$. (E.)
43. Multiply 687.28 by 32.68 , and divide the product by 236.384 . (G. 78.)
44. Multiply $.048$ by $.021$, and divide the result by $.0189$. (* G. 82.)
45. Multiply $.0017$ by 700 and the product by 1.02 ; and divide 5.4 by $.00072$ and the quotient by 150 . († S. 81.)
46. Multiply together 3.5 , $.0077$, and $.000306$, and divide the product by $170 \times .00049 \times 165$. (* S. 86.)
47. Multiply together 97.8 , 129.7 , and 8.75 , and divide the product by 133.9 , carrying the division to two places of decimals. (G. 81.)

48. Multiply $1.\dot{1}4285\dot{7}$ by $1.\dot{2}7$, and divide the result by $.10389\dot{6}$. (* G. 86.)
49. Divide $2\frac{1}{3} + 4\frac{2}{5}$ by $5\frac{2}{7} - 4\frac{1}{11}$, and express the result as a decimal. (* G. 82.)
50. Add the product of 2.83 by .013 by .004 to the quotient of 9.6195 by 12.1. (* S. 81.)
51. Express as decimals $\frac{1.01 + .001}{10.11} + \frac{2.032 + 3.023}{5}$;
and $\frac{19350}{1575}$. (E. 83.)
52. Simplify

$$\frac{.13 \times .014 \times .01 + .012 \times .13 \times .01 - .12 \times .14 \times .002}{.01 \times .2 \times .015}$$
 (* S. 84.)
53. Reduce to a single decimal $\frac{3.375 - 2.83}{2.6 + 1.125} + 4.28571\dot{4}$.
54. Find the value to two places of decimals of

$$\frac{.01}{1.1} + \frac{.12}{3.3} + \frac{2.64}{4.4}$$
 (* E. 85.)
55. Multiply $6.38407 \times .0378$ correct to five places, and divide $.0041\dot{6}$ by $.083$. († S. 84.)
56. Add together $13.28360\dot{7}$, $29.30\dot{2}$, and $81.4\dot{6}$, and divide the sum by $68.048\dot{2}$, obtaining the quotient to four places of decimals. (* E. 86.)
57. Multiply (1) 2.3001 by 3.0400; (2) 3.14159876 by 34.003457 ; and divide 2.3001 by .000304. Bring out your results correct to five places, and use the shortest method you know. (* S. 78.)
58. Add together 3.6789 , $.0019\dot{4}$, $10.1534\dot{6}$, and $315.68\dot{9}$, and multiply the sum by 3.14111 , the final result to be correct to the seventh place of decimals.
59. Reduce (1) 18s. 4½d. to the decimal of £1;
 (2) 12 min. to the decimal of an hour. (E. 81.)

60. Express 5 yd. 1 ft. 6 in. as the decimal of a mile. (A. 81.)
61. Express 15 threepences as a decimal part of a guinea. (* G. 82.)
62. Express $5\frac{1}{4}$ d. as the vulgar fraction of a sixpence, and as the decimal fraction of half-a-crown. (E.)
63. Reduce 4s. 7d. to the decimal of a pound, and 40.6 square yards to the decimal of an acre. (G. 79.)
64. What fraction of 12s. 8d. is $\frac{2}{5}$ of $11\frac{1}{4}$ d. ? Express as a decimal. (* E. 75.)
65. Express £1, 2s. 7d. as the decimal of £24, 7s. 4d., and divide the result by .84. († E. 75.)
66. Find a decimal fraction corresponding to $\frac{7}{27}$. Reduce 10 of half-a-crown to the decimal of 17s. 6d. († S. 81.)
67. Reduce $\frac{1}{15}$ to a decimal; and $\frac{1}{15}$ of a guinea to the decimal of £1. (* E. 71.)
68. Express £3, 6s. $3\frac{1}{4}$ d. as a decimal (1) of a pound; (2) of a shilling; (3) of a halfpenny. (* S. 78.)
69. Required the value of £.5675 and .375 cwt. (E.)
70. Find the value of .1527 of $\frac{4}{5}$ of £3, 15s. (G.)
71. Multiply .875 by .075. If the result be the decimal of £1, how much does it represent? (G.)
72. To .378 of £7, 19s. 6d. add $\frac{5}{11}$ of £8, 6s. 3d. (G.)
73. Add together £.02 and .75 of a shilling, and subtract $3\frac{1}{8}$ farthings from the sum. .
74. Find the value of .878125 of £1 + .375 of a guinea - $5\frac{3}{8}$ of 1s. (E.)
75. Multiply £4, 5s. by 1.5, and express the answer in pounds, shillings, and pence. (E.)
76. Express .0075 as a vulgar fraction, and find the value of 2.125 of £8, 5s. (E.)
77. Find the value of $\frac{2}{5}$ of £7, 10s. 6d. - $\frac{1}{18}$ of .0325 of £250 + .0875 of £13, 13s. 4d. (A. 81.)
78. Express in lb. .03125 of a ton - .00625 of 5 cwt. + .175 of a qr. - 1.35 of a stone.

79. Find the value of $.42857\bar{1}$ of £5, 7s. $5\frac{3}{4}$ d. + $.1\bar{3}$ of 16s. $10\frac{1}{2}$ d. - $.375$ of $(1\frac{5}{6} - \frac{2}{7})$ of 18s. 8d. + £1, 3s. $10\frac{1}{2}$ d. (* A. 82.)
80. Express as a decimal fraction of a pound $\frac{1}{2}$ of £1 + $\frac{1}{2}$ of 6s. 8d. + $\frac{1}{3}$ of 13s. 4d. (E. 84.)
81. Find the value of $\frac{4}{11}$ of £1, 8s. $10\frac{1}{2}$ d., and express your result as the decimal of £250. (A. 83.)
82. Find what decimal 3s. $7\frac{3}{4}$ d. is of 18s. $2\frac{3}{4}$ d., and evaluate $.8725$ of a ton. (E.)
83. Find the value of $(\frac{2}{3} \times \frac{3}{16})$ of £1 + $.23$ of 4s. 2d. + $(5 - \frac{2}{3})$ of 1d., and express the result as a decimal of £1. (E.)
84. Find the value of $\frac{4}{5}$ of $\frac{1}{7}$ of $1\frac{5}{16}$ of $1\frac{1}{8}$ of 2470 guineas, and reduce the result to pounds and the decimal of a pound. (* G. 83.)
85. A man possesses $.1041\bar{6}$ of a vessel worth £8750; find the value of his share.
86. Find the value of $\frac{3}{7}$ of $.315$ of 8s. 4d. + $\frac{1}{4}$ of $(\frac{5}{7} - \frac{1}{3})$ of 2s. $7\frac{1}{2}$ d. - 6d., and express your result as the decimal of £100. (* A. 83.)
87. Add together $.60625$ of £1, $.234\bar{5}$ of £6, 17s. 6d., and $\frac{2}{11}$ of $\frac{3}{7}$ of £3, 5s. 1d., and reduce the sum to the decimal of £1, 17s. 6d. (* S. 83.)
88. Find the value of $.0375$ of £3, 6s. 8d. - $.225$ of 7s. 6d., and express your result as the decimal of 2s. 6d. (A. 84.)
89. Add together $.477\bar{2}$ of £5, 10s., £15.125, 17.3125s. and 9.75 d., and reduce the sum to the decimal of £25. (* S. 86.)
90. Find the value of $.0375$ of £43, 6s. 8d., and express 4 lb. 13 oz. as the decimal of $5\frac{1}{2}$ cwt. (A. 82.)
91. Reduce 4 cwt. 2 qr. 7 lb. to the decimal of a ton.
How much is $.31\bar{6}$ of a mile, and how much is $.547$ of an acre? (* G. 81.)
92. Find the value of $.225\bar{9}$, and reduce £3, 17s. $7\frac{3}{4}$ d. to the decimal of £1. († S. 84.)

93. Divide .000101 by .02, and $.12\bar{3}$ by $.00034\bar{3}$, and reduce £12, 14s. $7\frac{1}{2}$ d. to the decimal of a pound. († S. 85.)
94. Simplify
 (1) $\frac{2.1825 \times .0046}{.0002425}$;
 (2) $\frac{.1 \text{ cwt.} + .2 \text{ qr.} + .3 \text{ lb.}}{.0171}$. (E. 82.)
95. Multiply .0235 by 8.08, divide .0625 by .25, and find the value of $.41\bar{6}$ of £1. († S. 80.)
96. Reduce to a decimal of a £, £12, 13s. $7\frac{1}{2}$ d. and £9, 9s. $9\frac{1}{4}$ d., and find the cost of 1000 articles at each of these prices. (* S. 85.)
97. A litre is .2201 of a gallon. Find the number of pints in 10 litres, and the number of gallons in 73 litres. (E.)
98. A French metre = 1.0936 yd. Find a centimetre ($\frac{1}{100}$ of a metre) in decimals of an inch. (* S. 83.)
99. A kilogramme is 15432.35 grains. How many lb. avoirdupois is it? (E.)
100. If the circumference of a circle be 3.14159 times the diameter, find the diameter of a circle whose circumference is 2 miles 3 fur. 38 po. 9.226 yd. (* A. 86)

EXERCISE VI.

SIMPLE PROPORTION.

1. If a flock of 80 sheep cost £360, how many sheep will there be in a flock that costs £607, 10s.? (E.)
2. The sum of £27, 16s. 5d. is to be divided into 17 equal shares. What is the value of 3 shares? (E.)
3. A piece of silk 29 yards long is valued at £7, 9s. $2\frac{1}{4}$ d. How much may be bought for £4, 7s. $5\frac{1}{4}$ d.? (G.)

4. A person in 87 days spends £38, 19s. 4½d.; in how many days will he spend £163, 9s. 9½d. at the same rate? (S. 84.)
5. If a man receives £1, 2s. 6d. for five days' work, how much will he make in a year if he be absent from work 17 days besides Sundays? (G.)
6. A workman was absent from his work on 36 days in 1883 besides Sundays, and his wages amounted to £65, 15s. 9d. How much would he have had if he had missed only the Sundays? (G.)
7. If 14 yards of cloth can be bought for £6, 3s. 1d., how much will 375 yards cost? (G. 85.)
8. If 7 yards of cloth cost £1, 16s. 8d., what will be the value of 327 yards at the same rate? (G. 80.)
9. If 17 yards of cloth cost 19s. 10d., how much will 12 pieces, each 24 yards long, cost? (G. 78.)
10. If 48 yards of silk are worth £28, 15s., and 120 yards of cloth worth £7, which is the more valuable, 11 yards of silk, or 113 yards of cloth? (G.)
11. If 6 cwt. 2 qr. cost £18, 19s., how much will 18 cwt. cost? (E.)
12. If 25 cwt. 2 qr. of sugar cost £59, 10s., how much can be bought for £6, 14s. 2d.? (E.)
13. If the carriage of 5 cwt. 14 lb. for 96 miles be £1, 12s. 6d., how far may 3 cwt. 1 qr. be carried for the same money? (E.)
14. If an ounce of silver cost 5s., what is the cost of a cup weighing 1 lb. 5 oz. 12 dwt.? († S. 80.)
15. There are 25 francs in a sovereign; how many francs are there in £278, 6s. 8d.? (E.)
16. At 7s. 6d. per ounce, what is the value of silver-plate weighing 9 oz. 13 dwt. 8 gr.? (G.)
17. A scuttle of coals is charged 8d. when coals are 36s. a ton; how much ought the scuttle to hold? (E. 76.)
18. What cost 6 hogsheads of sugar, each weighing 9 cwt. 3 qr. 14 lb., at £2, 12s. 6d. per cwt.? (S. 83.)

19. An Austrian souverain and gold ducat are worth 13s. 11d. and 6s. 6d. respectively. How many ducats are equivalent to 4560 souverains? (E.)
20. A man's annual income is £300; he spends on an average 15s. 8d. per day. What does he save each year? (*G. 82.)
21. A servant is hired at £51, 2s. per annum. Beginning work on 14th Oct. 1873, he leaves on 1st May 1874. What wages should he receive? (E.)
22. If a person travel 7 miles in 1 hour 45 minutes, how long will he take to go 31 miles at the same rate? (G. 80.)
23. If 3 cwt. 14 lb. of a certain substance cost £52, 10s. 6½d., what will be the cost of 5 lb. 4 oz. of the same substance? (A. 82.)
24. If the carriage of 6 cwt. 3 qr. for 124 miles costs £3, 4s. 8d., what weight can be carried the same distance for £1, 4s. 3d.? (E.)
25. How much silver is in 9 ingots of an average weight of 2 lb. 7 oz. 14 dwt. 16 gr. each? Find the value of the whole at 4s. 10d. per ounce. (G. 83.)
26. A train moves at the rate of 30 miles an hour; how many feet does it go in one second? (E. 83.)
27. A skater moves at the rate of 12 miles an hour; express his velocity in yards per second. (G.)
28. A train travels at the rate of 60 feet per second. Express to two places of decimals the number of hours it will take to travel between Edinburgh and London, a distance of 405 miles. (E. 82.)
29. A train is moving 27 miles an hour. There are telegraph poles on the line 60 yards apart. How many will the train pass in 10 minutes? (G.)
30. A Roman mile contains 4842 English feet. A person can walk 3 English miles in an hour; how long will he take to walk 9 Roman miles? (E. 79.)

31. A train is 120 yards long, and is moving at the rate of 15 miles an hour. How long will it take to cross a bridge 760 yards in length? (G.)
32. The carriage of 2 tons 13 cwt. 2 qr. 16 lb. for 46 miles costs £2, 10s. What distance should 15 cwt. 3 qr. 24 lb. be carried for the same charge? (E. 77.)
33. The value of an ounce troy of standard gold is £3, 17s. $10\frac{1}{2}$ d. What is the exact weight in grains of a sovereign? († E. 71.)
34. Given that 1 lb. avoird. contains 7000 grains troy, find the troy weight of 35 lb. 13 oz. avoird. (S. 79.)
35. Express 1000 dollars in francs; given a dollar = 4s. $1\frac{1}{2}$ d., and a franc = $9\frac{1}{2}$ d. (* S. 83.)
36. If 36 men finish a work in 44 days, how long will it take 66 men? (E. 73.)
37. If 5 men can do a piece of work in 23 days, in what time would 13 men do it working at the same rate? (G. 83.)
38. If the 6d. loaf weighs 3 lb. when wheat is at 34s. a quarter, what should it weigh when wheat is at £2? (E. 74.)
39. If 100 lb. be carried 120 miles for a certain sum, how far ought 60 lb. to be carried for the same sum? (E. 81.)
40. How many yards of cloth at 1s. $10\frac{1}{2}$ d. per yard should be given in exchange for 345 pairs of boots at 18s. per pair? (E. 77.)
41. If the fore-wheel of a carriage, whose circumference is 8 feet, turns 3454 times in passing over a certain distance, how many turns will the hind-wheel make whose circumference is 11 feet? (S. 78.)
42. If a man walking at the rate of 4 miles an hour can travel a certain distance in 2 hours 15 minutes, in what time could he run the distance at the rate of $7\frac{1}{2}$ miles an hour? (* E. 76.)

43. A garrison in siege have provisions for 54 days at the rate of $1\frac{1}{2}$ lb. of bread per day; what must be the ration of bread in order to prolong the siege to 80 days? (E.)
44. A person pays £12, 10s. of income-tax on £750; what is the rate per pound? (E.)
45. If a person whose income is £700 a year pays an income-tax of £17, 10s., what is that in the £? (E.)
46. A sum of £386, 3s. 9d. is to be raised in a parish of which the rental is £6179. Find the rate per £. (E.)
47. The rental of a parish being estimated at £3766, 5s., what sum will be raised by a rate of 8d. in the pound? (E.)
48. Find the income of a person who pays £22, 7s. 5d. income-tax at 7d. in the £. (E.)
49. Find the income of a man who pays £10, 11s. 9d. for taxes, when the rate is $5\frac{1}{2}$ d. in the £. (E. 79.)
50. Find the income of a man who pays £5, 4s. $10\frac{1}{2}$ d. of income-tax when the rate is $4\frac{1}{2}$ d. in the £. (E.)
51. Find the difference between the amounts paid as income-tax, when
 (1) the income is £500 and the tax 5d. in the £.
 (2) " £400 " 8d. " " (E. 85.)
52. If, when the income-tax is raised $2\frac{1}{2}$ d. in the £, a man has to pay £3, 19s. 2d. more as income-tax than formerly, what is his annual income? (*E. 85.)
53. After paying income-tax at the rate of 5d. in the £, a man has £636, 9s. 2d. remaining. What is his gross income? (E. 76.)
54. A gentleman pays 10d. in the £ as income-tax; all his other expenses amount to £5 a week, and he saves £85 a year. What is his whole annual income? (E. 83.)

55. A bankrupt's effects are £563, 14s. 7½d., and his liabilities £1471, 8s. 4d. What does he pay in the £, and how much per cent. ? (S. 85.)
56. A bankrupt who pays 7s. 6d. in the pound divides among his creditors £1575; what do his debts amount to? (E.)
57. The estate of a bankrupt pays 4s. 4½d. in the £; what loss will a creditor sustain whose claim is for £337, 6s. 8d.? (E.)
58. If 2¼ yards of cotton cost 3s. 9d., what will be the cost of 13⅝ yards? (E.)
59. If 3½ lb. cost 7s. 3d., how many lb. can be purchased with 25 guineas? (E.)
60. If £11, 1s. 4½d. can purchase 38½ yards of cloth, what will 13 yards 3 qr. cost at the same rate? (G. 82.)
61. If 16⅔ yards of cloth can be bought for £12; 18s. 4d., how much will £60, 9s. purchase? (G. 84.)
62. Find how many yards of cloth are in 25 pieces, each 21½ yards long, and how much it costs at 3s. 4d. a yard. (G. 78.)
63. If ⅔ of a field of 45 ac. 3 ro. 25 po. cost £90, what is the value of the land per acre? (S. 78.)
64. If 17 yards of cloth cost as much as a cwt. of butter, how many lb. of butter should be given in exchange for 3 bales of cloth, each containing 43½ yards? (E. 71.)
65. A railway train travels at the average rate of 5½ miles in 17¼ min. Find how long it takes to go 84 miles. (G. 79.)
66. How far will a person walk in 179¼ days, allowing that he walks each day 21 miles 3 fur. 15 poles? (S. 80.)
67. If 14 men can do a piece of work in 17¼ days, how long will it take 35 men to do the same work? (E. 82.)

68. If a man go 45 miles in a given time, walking at the rate of $3\frac{3}{4}$ miles an hour, how far will he go in the same time, walking at the rate of 4 miles an hour? (A. 84.)
69. A gang of reapers can reap 84 ac. 3 ro. 14 poles in $13\frac{3}{4}$ hours. In how many hours can they reap 401 acres 8 poles? (S. 85.)
70. An English mile is .2316 of a German mile. A person walks a German mile in 66 minutes. How long will he take to walk an English mile? (E.)
71. If .375 cwt. cost £.5675, what does 3.83 tons cost? (* S. 80.)
72. If 1.3 ounces of gold cost £5.586, what is .83 of a lb. worth (troy weight)? (G. 81.)
73. Express $69\frac{1}{2}$ miles in metres, a yard being equal to .9143 of a metre. († S. 83.)
74. How many lb. of tea at $\frac{1}{2}$ of a shilling per ounce should be given in exchange for 17 pieces of cloth, each containing 5 yards 3 qr. 2 nails, at 11.52s. per yard. (* E. 71.)
75. Find the value of $127\frac{5}{16}$ acres of land, if 32 acres 3 roods of it are worth £6, 2s. 6d. per acre, and the remainder worth £7, 7s. 2d. per acre. (G.)
76. If a metre is equal to 39.3708 inches, how many metres are there in 2 miles 5 fur. 32 po. 4 yards? (E. 77.)
77. A gas stove burns 7 cubic feet of gas per hour, and the cost of the gas is four shillings per 1000 cubic feet; find the hourly cost. (E.)
78. Find the cost of electric lighting for 3 months with 60 lamps burning on an average 8 hours per day, the rate of charge being $2\frac{1}{4}$ d. per lamp per hour. (E.)
79. What is the cost per hour of lighting a room with 20 burners, each consuming 4 cubic inches of gas per second, the price of gas being 6s. for 1000 cubic feet? (G.)

80. A mass of silver is £1000 of our present coinage, when silver is worth 5s. 6d. per oz. troy. What would have been its nominal worth in the reign of Henry VII., when silver was worth £1, 17s. 6d. per lb. troy? (E. 75.)
81. Nine men are engaged to perform a piece of work in 22 days, but 3 men leave after working 6 days. Find how long the remaining 6 men will take to finish the job. (G. 81.)
82. If 128 yards of paper are required to paper the four walls of a room with paper $\frac{3}{4}$ yard wide, how many yards will be required when the paper is $2\frac{1}{2}$ ft. wide?
83. If a man's step is 2 ft. 6 in., how many must he take in a minute, so as to walk at the rate of 5 miles an hour? (E.)
84. In a mile race one man loses one yard in every fifteen he runs. By how much will he lose the race? (E.)
85. If the price of the 4-lb. loaf is $5\frac{1}{2}$ d. when wheat is 5s. per bushel, what ought its price to be when wheat is at 6s. 3d. per bushel, supposing that 2d. per loaf covers the cost of the workmanship? (E.)
86. A clock which was 1.4 minutes fast at a quarter past 4 P.M. on March 12th, is 6 minutes slow at 9 A.M. on March 15th. When was it right? (E.)
87. In painting 57 square yards of wall, it is found that 26 lb. 2 oz. of paint had been used. How much will be required for a wall 63 feet long and 15 feet high? (G.)
88. If A can run at the rate of 9 miles an hour, and B at the rate of $8\frac{1}{2}$ miles an hour, what start must B have in order that in a race of 100 yards they may finish at the same time? (+ E. 85.)
89. A fast train starts $2\frac{1}{2}$ hours after a slow one. When and where will it overtake the latter, their rates being 40 and 32 miles per hour respectively? (+ S. 84.)
90. A travels at the rate of $3\frac{1}{2}$ miles an hour, and B follows him 4 hours after at the rate of 4 miles an hour. How many miles has A travelled before B overtakes him? (+ E. 82.)

EXERCISE VII.

COMPOUND PROPORTION.

1. If 16 men reap 76 acres in 4 days, how many men will reap 114 acres in 6 days? (E.)
2. If 135 cwt. carried 65 miles cost £1, 9s. 3d., what will 60 cwt. carried 180 miles cost? († S. 82.)
3. If it cost £61, 18s. 5d. to keep 2 horses for 11 months, how long can 3 horses be kept for £59, 2s. 11½d.? (E.)
4. If 5 men earn £15 in 5 days, how many men will earn 20 guineas in 7 days? (A. 80.)
5. How far should 80 cwt. be carried for £29, if 30 cwt. be carried 17 miles for £5, 8s. 9d.? (S. 83.)
6. If 7 pipes can empty a reservoir, running 3 hours a day for 15 days, how long will 5 pipes take to empty it, running 6 hours a day? (E.)
7. If a man walk 252 miles in 6 days of 9 hours each, how far will he walk at the same pace in 7 days of 8 hours each? (E.)
8. If 64 cwt. carried 40 miles cost 10s. 8d., what will 80 cwt. carried 63 miles cost? (E.)
9. If 21 men in 27 days receive £141, 15s. of wages, how many men must work 21 days to earn £157, 10s.? (E.)
10. If 3 men, working 7 hours a day, earn £4, 3s. 5d. in 3½ days, how much will they earn in 22½ days, working 8 hours a day? (A. 81.)
11. If 4 men can do a piece of work in 9 days, working 10 hours a day, in what time should 6 men do it, working 8 hours a day? (G. 78.)

12. If 9 men, working 8 hours a day, can earn £36 in 20 days, how much will 19 men, working 10 hours a day, earn in 30 days? (E. 84.)
13. If 3 men can mow 7 acres in 5 days of 9 hours each, in how many days of 8 hours each will 5 men mow $17\frac{1}{2}$ acres? († S. 80.)
14. If 7 men earn £8, 12s. $6\frac{1}{2}$ d. in a given time, when wages are $6\frac{1}{2}$ d. per hour, find how much 10 men will earn in the same time when wages are 8d. per hour. (A. 82.)
15. What time would 36 men, working $10\frac{1}{2}$ hours a day, require to build a wall which 24 men, working $9\frac{1}{2}$ hours a day, can build in 9 days? (E.)
16. How far ought $4\frac{3}{4}$ cwt. to be carried for 11s. $10\frac{1}{2}$ d., when the carriage of $17\frac{1}{4}$ cwt. for 52 miles cost 8s. 4d.? (E.)
17. If the wages of 10 men for 12 weeks, working 10 hours a day, amount to £150, what will the wages of 22 men amount to in $3\frac{1}{2}$ weeks, when they work only 9 hours a day? (G. 81.)
18. If a person walking 22 miles a day can perform a journey in 8 days, how long will he take to perform a journey $2\frac{1}{2}$ times as long, walking 19 miles a day? (G. 80.)
19. If 5 men build a wall 100 yards long in 12 days, working 9 hours a day, how many men will it take to build a similar wall 770 yards long, in 11 days, working 7 hours a day? (E.)
20. How many pages of a magazine will a manuscript occupy which has 123 pages, each of 28 lines, with 7 words per line on an average, while a page of the magazine has 46 lines, with 10 words per line on an average? (E.)
21. I agree to pay a man £5, 13s. 9d. for working at a certain rate during a certain time. He is absent $\frac{4}{5}$ of the time, and when present, works at only half the rate agreed on. What should I pay him? (E.)

22. A certain piece of excavation cost £1347. How much would it have cost if the wages of the workmen per day had been increased by one-eighth, and the length of the working day increased by one-twentieth? (S. 79.)
23. If 8 men reap a field 484 yards long and 240 yards broad in a given time, how many men would reap a field $\frac{1}{4}$ as long again and $\frac{1}{2}$ as broad again in half the time?
24. If 17 men dig a field in 6 days, how long will 4 boys take to dig the field, assuming that one man can do twice as much work as a boy? (E. 80.)
25. If 7 men can plant 945 rows of potatoes in 3 days of 9 hours each, how many women will plant 1200 rows in 5 days of 8 hours, if 4 women can do as much as 3 men?
26. A train is travelling at the rate of 40 miles an hour. Find to two places of decimals its speed in metres per second. (1 metre = 39.37 in.) (* E. 86.)
27. If 4 oranges be worth 5 eggs, and 2 eggs worth 7 pears, and if pears cost 4d. a dozen, what is the price of oranges a dozen? (* E. 85.)
28. If $\frac{1}{2}$ of a sheep be worth £ $\frac{2}{3}$, and $\frac{2}{7}$ of a sheep be worth $\frac{1}{14}$ of an ox, find the price of 100 oxen. (E. 80.)
29. In a race of 100 yards, A can beat B by 5 yards, and B can beat C by 5 yards. By how much can A beat C? († E. 78.)
30. A beats B by 10 yards in 100 yards, and B beats C by 10 yards in 100 yards. By how many yards will A beat C in 1000 yards? (E. 82.)

EXERCISE VIII.

PRACTICE AND BILLS OF PARCELS.

1. Find, by Practice, the price of 218 cwt. at £5, 18s. 4d. per cwt. (E. 73.)
2. Find, by Practice, the value of 7630 articles at 6s. 2½d. each. (E. 76.)
3. Find, by Practice, the cost of 8349 articles at 16s. 11d. each. (* E. 77.)
4. Find, by Practice, the price of 3119 things at £4, 7s. 7d. each. (E. 78.)
5. Find, by Practice, the value of 9186 articles at £2, 19s. 11½d. each. (E. 79.)
6. Find the value of 875½ tons of iron at £4, 12s. 5d. per ton. (G. 79.)
7. Find, by Practice, or otherwise, the value of 759 articles at £5, 3s. 8½d. each. (E. 80.)
8. Find the value of 2762 articles at £2, 14s. 6d. each, by the rule of Practice. (G. 81.)
9. Find, by Practice, the cost of 2153 articles at £1, 4s. 10½d. each. (G. 81.)
10. Find, by Practice, the value of 713 articles at £4, 8s. 11½d. each. (S. 83.)
11. Find, by Practice, the value of 356½ tons at £1, 13s. 5½d. a ton. (S. 84.)
12. Find, by Practice, the value of 7394½ things at £12, 8s. 8½d. each. (S. 85.)
13. Find, by Practice, the cost of 36,725½ articles at £3, 18s. 10½d. each. (E.)
14. Find the cost of 13 cwt. 3 qr. 16 lb. at £11, 19s. 5d. per cwt. (E. 71.)
15. Find the cost of 99 cwt. 3 qr. 21 lb. at £144, 11s. 4d. per cwt. († E. 73.)

16. Find the cost of 143 cwt. 3 qr. 14 lb. at £11¹/₂, 14s. 8d. per cwt. (E. 74.)
17. Find, by Practice, the cost of 17 cwt. 3 qr. 14 lb. at £184, 17s. 3d. per cwt. (E. 75.)
18. Find, by Practice, the cost of 24 ac. 3 ro. 25 po. at £76, 2s. 6d. per acre. (* E. 76.)
19. Find, by Practice, the cost of 343 ac. 2 ro. 25 po. at £2, 4s. 10d. per acre. (E. 77.)
20. Find the cost of 16 cwt. 2 qr. 27 lb. at £1, 17s. 4d. per cwt. (* G. 82.)
21. Find the price of 191 ac. 3 ro. 27 po. at £42, 3s. 4d. the acre. (* G. 83.)
22. Find the price of 3 tons 18 cwt. 2 qr. at £2, 10s. 6d. per cwt. (G. 84.)
23. Find the cost of 78 tons 3 cwt. 27 lb. at £5, 8s. 10d. per ton. (* S. 85.)
24. Find the amount of the following grocer's bill:
- | | | |
|-----------------------------------------|------------------------------------------------|----------|
| 2 ¹ / ₂ lb. tea | at 3s. 5d. per lb. | |
| 4 lb. bacon | " 1s. 1 ¹ / ₂ d. per lb. | |
| 9 ³ / ₄ lb. sugar | " 5 ³ / ₄ d. per lb. | |
| ¹ / ₂ oz. pepper | " 9d. per oz. | |
| 8 eggs | " 1s. 2d. per dozen. | (S. 78.) |
25. 3 cwt. at £3, 13s. 3d. per cwt.; 7 cwt. at 19s. 10d. per qr.; and 15 cwt. at 8³/₄d. per lb.; find the total value. (S. 80.)
26. Find the amount of the following bill:
- | | |
|----------------------------------------------|---------------------------------------------------|
| 9 ¹ / ₂ yards of cloth | at 4s. 7 ¹ / ₂ d. per yard. |
| 3 ³ / ₄ lb. of tea | " 3s. 3d. per lb. |
| 5 stones of sugar | " 3 ¹ / ₂ d. per lb. |
| 10 stones of flour | " 1s. 11d. per stone. |
27. Make out a bill for the following:
- | | |
|-----------------------------------|---------------------------------------------------|
| 6 pieces of cloth, each 25 yards, | at 5s. 9 ¹ / ₂ d. per yard. |
| 9 " calico, | " 45 " 5 ¹ / ₂ d. " |
| 14 " linen, | " 18 " 2s. 5 ¹ / ₂ d. " |
- (S. 83.)

28. Make out a bill for the following articles: $3\frac{1}{2}$ at $6\frac{1}{2}$ d. each; 10 at 2s. 7d. each; $6\frac{1}{4}$ at 11s. 5d. each; and 12 at $9\frac{1}{2}$ d. each. (E.)
29. Make out a bill for the following :
- | | | |
|----------------------|----------------|------------------------------------|
| 8 pieces of silk, | each 27 yards, | at 7s. $8\frac{1}{2}$ d. per yard. |
| 12 " muslin, | " 44 " | 3s. $9\frac{1}{2}$ d. " |
| 14 " cotton, | " 19 " | 2s. $7\frac{1}{2}$ d. " |
- (S. 84.)
30. Find the amount of the following bill, and how much rebate the payer will get at the rate of one shilling in the pound :
- | |
|--------------------------------------------------------------|
| 95 cwt. of sugar at £12, 11s. 4d. per cwt. |
| 108 $\frac{1}{2}$ " " £11, 3s. 5d. " |
| 4 $\frac{1}{4}$ cwt. of tea at 3s. $3\frac{1}{4}$ d. per lb. |

EXERCISE IX.

DISTRIBUTIVE PROPORTION.

1. Divide 160 into three parts proportional to 1, 3, and 4. (E.)
2. Divide £36, 12s. among 3 persons in the proportion of 3, 4, and 5. (E.)
3. Divide £1200 among 3 persons in the proportion of 2, 3, 4. (* E. 73.)
4. Divide £236, 5s. among 3 persons, so that their shares may be proportional to 3, 5, and 7. (E.)
5. Divide £161, 11s. $9\frac{1}{2}$ d. between A, B, and C, so that for every £4 given to A, B may receive £9, and C £12. (E.)
6. Divide £28, 4s. among A, B, and C, so that for every shilling given to A, B may have two shillings, and C three shillings. (G.)
7. A, B, and C invest in business £450, £350, and £550 respectively. How ought a profit of £337. 10s. to be divided among them? (E.)

8. A man left £1933, 6s. 8d. to be divided among his 3 sons, so that their shares should be proportional to their ages, which were 18, 19, and 21. Find how much each received. (E.)
9. Three villages, containing respectively 250, 350, and 600 inhabitants, are required to furnish £720. How much ought each village to contribute? (E. 80.)
10. Two persons gained £135 by trading; the one had a capital of £1745, the other of £955. What was the share of each in the profits? (* E. 75.)
11. A bankrupt whose effects are worth £227, owes his creditors £185, £301, and £422 respectively. How much will each receive? (G.)
12. A bankrupt whose effects are worth £201, owes his creditors £133, £212, and £325 respectively. What will each receive? († S. 82.)
13. Divide £56, 5s. among A, B, and C, so that B may have twice as much as A, and C half as much again as A and B together. (E.)
14. A, B, and C build a wall for £33, 15s. How much should each receive if, when A builds 4 yards, B builds 5 yards, and when B builds $2\frac{1}{2}$ yards, C builds 3 yards?
15. A person at his death left £20,214 to be divided among his four sons A, B, C, D; B was to have $\frac{5}{8}$ of A, C $\frac{4}{5}$ of B, and D $\frac{3}{4}$ of C. What was the share of each? (* G. 80.)
16. Two trains start at the same time from London and Edinburgh; the former travels at the rate of 32 miles an hour, the latter at the rate of 23 miles. Where do they meet, the distance between the two cities being 405 miles? (E. 82.)
17. Two persons join in business, one investing £7000 for 12 months, and the other £5000 for 18 months; what share should each have in a profit of £872, 18s. ? (E.)

18. There are three partners in a business. A puts in £400 for 3 years, B £800 for $2\frac{1}{2}$ years, and C £1250 for 2 years, and the profits are £708, 15s. How ought they to be divided? (E.)
19. Loot, to the value of £1470, is divided among a colonel, 6 captains, and 116 privates; the share of a colonel, a captain, and a private being respectively in the proportion of 7, 4, and 1. Required the share of each. (E.)
20. A bill of £8, 3s. 4d. was paid with a certain number of pounds, three times the number of shillings, and four times the number of pence. Find the number of each coin used. (E.)
21. The sum of £11, 7s. 6d. is made up of a certain number of sovereigns, twice as many half-crowns, five times as many shillings, and ten times as many threepenny pieces. Find the number of each coin. (G.)
22. A debt of £18, 15s. 10d. is paid in crowns, shillings, and pennies, whose numbers are proportional to 3, 2, 1. Find the number of each coin. (E.)
23. Divide £13, 10s. into two parts, so that if one part be divided equally among 20 boys, and the other be divided equally among 35 men, each man will get twice as much as each boy; how much does each boy get? (E. 83.)
24. A, B, and C are partners in a business, their shares being proportional to the fractions $\frac{7}{5}$, $\frac{8}{3}$, and $\frac{6}{5}$. A's share of the profits is £450. Find B's share and C's share.
25. A person walked from Cambridge to Newmarket, a distance of 14 miles, and back, in 7 hours 30 min. His rate going was to his rate returning in the proportion of 8 : 7 Find the rates. (E.)

EXERCISE X.

SIMPLE INTEREST.

1. Find the simple interest on £452, 10s. for four years at $3\frac{1}{2}$ per cent. (E.)
2. Find the amount of £560 in $2\frac{1}{4}$ years at $4\frac{1}{2}$ per cent. simple interest. (E.)
3. Find the simple interest on £625 for 4 years at $4\frac{1}{2}$ per cent. (E.)
4. Find the simple interest on £4075, 10s. for $1\frac{1}{2}$ years at 4 per cent. (E. 74.)
5. What is the simple interest on £569, 3s. 4d. for 4 years at $2\frac{1}{2}$ per cent. ? (E. 76.)
6. Find the simple interest for one year on £625, 15s. at 4 per cent. per annum. (E.)
7. Find the simple interest on £217, 17s. 8½d. for 4 years at 5 per cent. (E.)
8. Find the simple interest on £291, 13s. 4d. for 6 years at $3\frac{1}{2}$ per cent. per annum. (E.)
9. Find the simple interest on £700 for 10 years at 5 per cent. (* E. 82.)
10. Calculate the simple interest on £415 for 3 years at $3\frac{1}{2}$ per cent. (* S. 78.)
11. What will £480 amount to in 3 years 3 months at £4, 3s. 4d. per cent per annum ? (E. 73.)
12. Find the simple interest on £2733, 6s. 8d. at $4\frac{1}{2}$ per cent. for 3 years 9 months. (* S. 83.)
13. Find the simple interest on £5756, 15s. in 128 days at $4\frac{1}{2}$ per cent. per annum. (E. 71.)
14. Find the simple interest on £365, 15s. for 292 days at 4 per cent. (S. 80.)
15. Find the interest on £166, 10s. 7½d. for 210 days at $3\frac{1}{2}$ per cent. per annum. (* G. 85.)

16. Required the interest on £345, 5s. for 245 days at 5¹/₂ per cent. per annum. (E.)*
17. What is the interest to the nearest farthing on £111, 18s. 1¹/₂d., from July 8 to December 26, at 5¹/₄ per cent. per annum? (* G. 86.)
18. What principal will amount to £500, 10s. in 5 years at 2 per cent. simple interest? (E.)
19. What principal sum will amount to £799, 15s. at simple interest for 2 years 5 months at 4¹/₂ per cent.? († E. 74.)
20. What principal will produce £37, 5s. of simple interest in 2¹/₂ years at 3 per cent.? (E.)
21. What sum of money will amount to £822, 10s. in 5 years at 3¹/₂ per cent. per annum? (* A. 84.)
22. What sum at £4, 15s. per cent. will yield £70, 14s. 7d. of interest in 16 months? (* S. 84.)
23. What sum lent on 1st January 1880 at 5¹/₂ per cent. per annum would amount to £1000 on the 29th Sept. of that year? (* S. 82.)
24. What principal at 5 per cent. will yield an income of £740, 5s.? (E.)
25. What principal invested at 6 per cent. is required to yield two bursaries, one of £35, the other of £17, 10s.? (E.)
26. A certain sum of money gains £131, 5s. in 4 years at 3³/₄ per cent. Find the sum, and find also what it would gain in double the time at two-thirds of the rate.
27. State the rule for finding the simple interest on a given sum for a given number of years.
Find what sum will amount to £45,990 in 6 years at 4¹/₂ per cent. simple interest. (E.)
28. In what time will the interest on £537, 10s. amount to £80, 12s. 6d. at 4¹/₂ per cent. per annum? (* S. 85.)
29. In what time will £750 produce £82, 10s. at 2¹/₂ per cent. per annum? (E.)

30. In how many years will £1736, 13s. 4d. amount to £4371, 6s. 8d. at 4 per cent. per annum? (E.)
31. A sum of £225 was deposited at $3\frac{1}{2}$ per cent. on 28th March. On withdrawing principal and interest, the depositor received £228, 3s. On what date did he withdraw it?
32. At what rate per cent. simple interest will £326 in 15 years become £546, 1s.? (* G. 83.)
33. If £19, 4s. amount to £22, 16s. in 3 years at simple interest, what is the rate per cent.? (E.)
34. At what rate per cent. will a sum of money double itself in $33\frac{1}{3}$ years?
35. A sum of £850 amounts to £939, 5s. in 3 years. How much will it amount to in 5 years at the same rate per cent.?
36. The interest for one year on £2500, after deducting income-tax at 8d. per £, is £102, 14s. 2d. Find the rate per cent. (* S. 86.)
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EXERCISE XI.

PROFIT, AND LOSS.

1. A person bought 250 yd. of cloth at 13s. 4d. per yard, and sold it at 16s. 8d. per yard. What was his profit? (E.)
2. Find the cost of 473 articles at £3, 7s. $3\frac{1}{2}$ d. each, and determine the whole profit, supposing them sold at £3, 19s. $2\frac{3}{4}$ d. each. (E. 81.)
3. If I buy at 3s. 6d. and sell at 3s. $10\frac{1}{2}$ d., what do I gain per cent.? (E.)
4. A merchant buys cigars at £3, 10s. a hundred, and sells them at 1s. each. What per cent. does he gain? (E.)

5. A merchant mixes equal quantities of tea at 4s., 4s. 6d., 5s., 5s. 3d., 6s. 3d. per lb. respectively. Find the average cost per lb., and the gain per cent. by selling the mixture at 7s. 6d. per lb. (E.)
6. A merchant mixes 100 lb. tea at 2s. 6d. per lb., 50 lb. at 3s., and 100 lb. at 3s. 6d., and sells the mixture at 3s. 9d. per lb. What is his gain per cent. ? (E. 83.)
7. Formerly newspaper wrappers were sold at the rate of 8 for $4\frac{1}{2}$ d., and now they are sold at 12 for 7d. What is the percentage of increase on the price ? (E.)
8. A merchant buys cloth at 2s. $3\frac{1}{4}$ d. per yard, and sells it at 3s. $4\frac{1}{2}$ d. per yard. What is the percentage of profit on the outlay, and how many yards must he sell to gain £10 ? (E.)
9. By selling a book for 5s. 2d., a bookseller gains 24 per cent. What was the prime cost ? (E.)
10. A dealer selling a horse at £48, 12s. loses 10 per cent. on the cost price. Find the cost price. (E. 82.)
11. A merchant sold goods for £361, 6s. $11\frac{1}{2}$ d., gaining 7 per cent. on the cost price. What did the goods cost him ? (* G. 86.)
12. A merchant sells 20 articles of equal value for £8, 0s. 6d., and thus gains 7 per cent. What did he pay for each ? (E. 83.)
13. If 1830 articles were bought at 4s. $4\frac{1}{2}$ d., and sold at a profit of $17\frac{3}{4}$ per cent., how much did they realise ? († S. 84.)
14. After paying an income-tax of 10 per cent., a person has £1250 a year. What was his entire income ? (* E. 73.)
15. If the increase of the population be 20 per cent. per annum, what will a population of 1000 become in 10 years ? († E. 71.)
16. A man's clear income, after deducting 5 per cent. for collecting, is £1064. What was the gross income ? († E. 74.)

17. If the proportion, by weight, of pure gold in a sovereign be 92 per cent., and 50 sov. contain 1 oz. 12 gr. of alloy, what is the weight of a sovereign? (E.)
18. Find the rent of $305\frac{1}{2}$ acres at £4, 17s. 6d. per acre. If the landlord allows an abatement of 20 per cent., what does the tenant pay? (E.)
19. If by selling at 15s. per yard, you lose 10 per cent. on the outlay, what do you gain or lose per cent. when you sell at 17s. a yard? († E. 71.)
20. By selling an article at 10s., the seller loses 5 per cent. How much will he lose or gain by selling it at 12s.? (* S. 82.)
21. If by selling at 17s. 4d. per yard, you lose 20 per cent. on the outlay, what do you gain or lose per cent. when you sell at £1 per yard? (E. 75.)
22. If by selling at 17s. 6d. per yard, you gain 10 per cent., what do you gain or lose when you sell at 16s. per yard? (E.)
23. If by selling at 7s. 6 $\frac{1}{2}$ d. I gain 10 per cent., how much per cent. do I lose or gain when I sell at 7s. 1 $\frac{1}{2}$ d.? (E.)
24. If by selling at 22s. per cwt. 10 per cent. is gained, what is the price which will yield 20 per cent. profit? (* E. 79.)
25. If by selling at 4s. 9d. five per cent. be lost, what price must be charged so as to gain 10 per cent.? (* S. 81.)
26. If a man gain 5 per cent. by selling a horse for £115, 10s., at what price must he sell it if he is to lose 7 per cent.? (G.)
27. By selling a bullock for £20, a man said he had gained 5 per cent. Find how much he paid for it, and for how much he must sell it to gain 10 per cent.? (E.)
28. By selling an article for £2, 10s. 10 $\frac{1}{2}$ d. a man lost 5 per cent. on his outlay. What was the cost of the article, and for how much must he sell it so as to gain 12 per cent.? (E.)

29. By selling tea at 2s. 8d. per lb. I gain $\frac{7}{11}$ of what I paid for it. What should I have gained per cent. by selling it at 3s. per lb.?
30. The cost of A is 25 per cent. more than that of B, which is 14 per cent. less than C, which costs £2000. Find the cost of A. (* S. 85.)
31. A person bought a quantity of goods for £80, and sold one-fourth of them at a gain of 5 per cent. How much per cent. must he gain on the remainder so as to gain 20 per cent. on the whole? (E.)
32. A grocer buys $1\frac{3}{4}$ cwt. of tea at 2s. $2\frac{1}{2}$ d. per lb., and $2\frac{1}{4}$ cwt. at 1s. $10\frac{1}{2}$ d. He sells $2\frac{3}{4}$ cwt. at 2s. per lb. At what rate must the rest be sold so as to clear 20 per cent. on his outlay? († S. 83.)
33. If apples are bought for 4 a penny, and mixed with an equal number bought for 3 a penny, and then sold at the rate of 5 for 2d., what is the gain per cent.? (E.)
34. A tradesman's prices are 20 per cent. above cost price. If he allows a customer 5 per cent. on his bill, what profit does he make? (E. 76.)
35. A tradesman's prices are 25 per cent. above cost price. If he allows a customer 12 per cent. on his bill, what profit per cent. does he make? († G. 84.)
36. A tradesman gives his customers 8 per cent. discount on their bills, but the prices charged are 25 per cent. over what the goods cost him. What profit does he make on a bale costing £1000? (* G. 85.)
37. B sells to A at a profit of 80 per cent., but A fails, and pays only 6s. 8d. in the £. What percentage on his outlay does B gain or lose? († S. 83.)
38. A merchant sells goods to a shopkeeper at a profit of 80 per cent., but the latter becoming bankrupt, pays only 3s. 4d. in the £. What per cent. does the merchant lose? (E.)
39. A merchant buys at the rate of 9s. $4\frac{1}{2}$ d. and sells at the rate of 10s. 6d. per yard. How much profit will he have from £10 receipts? († E. 83.)

40. An article, in passing from the producer to the consumer, passed through the hands of 3 dealers, each of whom added 10 per cent. to the price at which he bought. The final price was £365; what was the original price? (E.)
41. If 6 per cent. more be gained by selling a pianoforte at 150 guineas than by selling it at £150, what was the prime cost? (E. 77.)
42. If $6\frac{1}{2}$ per cent. more be gained by selling a horse for £100 than for £94, 5s., find his original price. (* G. 84.)
43. A man buys eggs at 21 for a shilling, and sells them at 9d. per dozen. He draws in one day £1, 13s. 9d. How much profit has he made? (* S. 85.)
44. If eggs are sold at 9s. 4d. per 100 with a profit of 40 per cent. on the cost price, how many were purchased with one shilling? (E. 81.)
45. If the tax on a commodity be raised 20 per cent., and the consumption be in consequence diminished 12 per cent., what change is there in the yield of the tax, which was previously £15,133,921? († S. 85.)
46. A person buys 50 lambs, and intends to sell them at £1, 2s. 6d. each, thereby making 8 per cent. on the prime cost, but 5 lambs having died, what does he gain or lose per cent. by selling the remainder at the same rate? († S. 81.)
47. A bought a Geneva watch and paid duty at the rate of 10 per cent.; he sold it for £21, making a profit of 15 per cent. on his whole outlay. Find the original cost of the watch. († S. 84.)
48. Sold 10 sheep at a gain of 10 per cent., 20 at a gain of 20 per cent., and 12 at a loss of $16\frac{2}{3}$ per cent. Had I sold the whole at a gain of $8\frac{1}{3}$ per cent. I should have gained 15s. more. Find the cost price of a sheep.

49. At what price must 90 gallons of spirit worth 15s. a gallon be sold so as to clear 15 per cent. ? and how much water must be added to enable the spirit-dealer to sell the mixture at 15s. per gallon with the same profit ? (* S. 85.)
50. The populations of three contiguous burghs in 1871 were 42,913, 34,567, 67,324 respectively. They were then formed into one municipality. In 1881 the populations had increased respectively by 8, 10, and 11 per cent. By how much per cent. had the population of the joint municipality increased ? (* S. 85.)

EXERCISE XII.

COMPOUND INTEREST.

1. Find the amount, at compound interest, of £200 for 3 years at 5 per cent. per annum. (E.)
2. Find the compound interest on £3125 for 3 years at 4 per cent. (E.)
3. Find the compound interest of £1407, 10s. for 3 years at 4 per cent. (* E. 74.)
4. Find the amount of £1404 in 3 years at 4 per cent. compound interest. (* E. 75.)
5. Find the compound interest of £1000 in 5 years at 4 per cent. (* E. 71.)
6. Define simple and compound interest. Find the amount of £1000 for 4 years at 5 per cent. compound interest. (* E. 73.)
7. Calculate the compound interest on £415 for 2 years at $3\frac{1}{2}$ per cent. (* S. 78.)
8. Find the amount, at compound interest, at the end of 2 years, of £123 at 4 per cent. per annum, payable half-yearly. (E.)

9. Find (1) the simple, (2) the compound interest on £500 for 3 years at 4 per cent. (E.)
10. Find the amount, at compound interest, of £2345, at the end of 3 years, the rate for the first year being 5 per cent., for the second 6 per cent., and for the third 7 per cent. (E.)
11. Which is greater, and by how much? The simple interest on £20 for 3 years at 5 per cent., or the compound interest for the same time at $4\frac{1}{2}$ per cent. (E.)
12. Find the difference between the simple and compound interest on £4250 for 4 years at 5 per cent. (E.)
13. Find the difference between the simple and compound interest on £432 for 4 years at 5 per cent. (* E. 76.)
14. State the difference between simple and compound interest. Find the difference between the simple and compound interest on £1600 for 5 years at 5 per cent. († S. 85.)
15. Find to the nearest farthing the amount of £1000 for 7 years at 5 per cent, compound interest. († G. 86.)
16. A person borrows £200, and at the end of each year pays £50 to reduce the principal and pay interest at 5 per cent. How much will he remain in debt at the end of two years? (E.)
17. A person borrows £150 at 4 per cent. At the end of each year he pays in all £40. How much is he indebted at the end of 4 years? (* E. 77.)
18. Find the sum that will amount to £926, 2s. in 3 years at 5 per cent, compound interest. (* S. 83.)
19. What sum will amount in 3 years to £1000 at 6 per cent, compound interest? Bring out the result to the nearest shilling. (* S. 79.)
20. Will the compound interest of £1 for 3 years at 4 per cent, be more or less than half-a-crown?
If the rate be such that the compound interest of £1 for 3 years is exactly half-a-crown, what will it be for 6 years? († E. 75.)

EXERCISE XIII.

DISCOUNT.

1. A sum of £1928, 17s. is due $1\frac{1}{4}$ years hence. What amount should be accepted for present payment, reckoning at $3\frac{1}{2}$ per cent. ? (E.)
2. What is the present worth of £168, 17s. due one year hence, the interest of money being 5 per cent. per annum ? (E.)
3. Calculate the present value of £415 due 2 years hence, interest being reckoned at $3\frac{1}{2}$ per cent. (* S. 78.)
4. Calculate the present value of £535 due 3 years hence, simple interest being reckoned at $3\frac{1}{2}$ per cent. (* S. 79.)
5. What is the present worth of £634, 16s. 8d. due 4 years hence at $5\frac{1}{2}$ per cent. ? (* S. 80.)
6. What is the present worth of £970, 18s. 4d. due at the end of 19 months, at $4\frac{1}{2}$ per cent. per annum ? (* S. 82.)
7. How much will a merchant lose by accepting £100 as present payment of a debt of £105 due 9 months hence at 4 per cent. ?
8. Find ~~the~~ discount on £937, 2s. 6d. due 2 years hence at 5 per cent. compound interest.
9. Find the compound interest and true discount on £80 for 3 years at 5 per cent. (E.)
10. Define interest and discount, and point out the difference between them. A sum of £500 is due me $2\frac{1}{2}$ years hence. What is its present value, and what would a banker give me, the rate of interest being $4\frac{1}{2}$ per cent. ? (* S. 81.)
11. Find the difference between the simple interest and the discount on £750, 16s. 8d. due $2\frac{1}{2}$ years hence at $2\frac{3}{4}$ per cent. per annum. († G. 83.)

12. Find the difference between the simple interest and the discount on £760, 13s. 4d. at $3\frac{5}{8}$ per cent. for 68 days. (* S. 84.)
13. If the discount (practical) on a bill due 8 months hence, at $2\frac{1}{2}$ per cent. per annum, be £44, 3s. 8d., what is the amount of the bill? († S. 83.)
14. The present value of £678, 8s. due 16 months hence is £640. What is the rate per cent.? (E.)
15. The present worth of £574 due 6 months hence is £560. Find the rate of interest. (* A. 81.)
16. The rate of interest being $4\frac{1}{2}$ per cent., £720 will be accepted as present payment of a debt of £733, 10s. When is it due?
17. The difference between true discount and banker's discount on a certain sum for 4 months at 5 per cent. is 8s. 4d. Find the sum.
18. Find the banker's discount on a bill for £500 drawn March 3 at 4 months, discounted April 7 at 4 per cent.
19. How much will a banker allow for a bill of £750 drawn February 20 at 6 months, and discounted May 15 at $3\frac{1}{2}$ per cent.?
20. What does a banker gain by discounting at 5 per cent. on March 23 a bill for 6 months, dated 11th Nov., for £483, 6s. 8d.? (* S. 80.)

EXERCISE XIV.

STOCKS.

1. How much 4 per cent. stock at 96 can be bought for £1000? What annual income will it produce? (E.)
2. What income will be derived from investing £10,000 in the $2\frac{1}{2}$ per cents, selling at 98? (* A. 85.)

3. Find the income obtained by investing £18,669 in the 3 per cents. at $95\frac{1}{8}$, brokerage $\frac{1}{8}$ per cent. (E.)
4. A person invests £1271 in the 3 per cents. at 93. How much will he gain by selling out at $94\frac{1}{8}$? (No commission to be charged.) (E.)
5. Find the income of a person who invests £10,098 in the 3 per cents. at $93\frac{3}{8}$, paying his broker $\frac{1}{8}$ per cent. (E.)
6. A person invests £1000 in the stocks at $92\frac{1}{4}$. At what price must he sell out to clear £50? (E.)
7. A buys £100 of 3 per cent. stock at £90, and B buys £100 of $4\frac{1}{2}$ per cent. stock at £133. What return per cent. will each get for his money? (E.)
8. Which is the better investment, a 3 per cent. stock at $88\frac{1}{4}$, or a 4 per cent. stock at $117\frac{1}{2}$. (* S. 86.)
9. Which is the better investment, Bank stock paying 10 per cent. at 319, or 3 per cent. Consols at 96? (E.)
10. Which is the better investment, the $3\frac{1}{2}$ per cents. at 91, or the $4\frac{3}{4}$ per cents. at 114? and what would be the difference of income arising from investing £15,600 in each? (* A. 81.)
11. Investing a sum of money in a certain 3 per cent. stock would bring the same income as lending it at 4 per cent. What is the stock selling at? (* A. 80.)
12. A half-yearly income of £138, 15s. is derived from 3 per cent. stock at $92\frac{1}{4}$. Find the amount of the stock, and its value in sterling money.
13. A man invests £11,700 in the 4 per cents. at 90, and when they have risen to 96 he sells out and invests in the $3\frac{1}{2}$ per cents. at 78. Find the alteration in his income. (* A. 83.)
14. A man sells £10,000 3 per cent. stock at 96, and invests the proceeds in railway shares at £15 per share, the dividend on which is 10s. per share. Find how many shares he buys, and the change in his income. (E.)

15. A man buys £650 stock in the 3 per cents. at 90, and invests £400 in the 4 per cents. at 110. Find the whole sum expended, and the annual income secured. (E.)
16. A person buys £1000 3 per cent. stock at $96\frac{1}{2}$ per cent., and sells out at $88\frac{1}{2}$. How much does he lose thereby? If he re-invests his money at 4 per cent., find the change in his income. (E.)
17. A person has £5900 in the 3 per cents. at $83\frac{1}{2}$. When the funds have fallen to 81 he sells out, and invests in the 5 per cents. at 108. Find the change in his income. (* A. 86.)
18. A capitalist invested £66,079 in Caledonian shares at 102, which were paying a dividend of 5 per cent. When they had risen one per cent. he sold out and bought North British shares at 92, the dividend being $4\frac{1}{2}$ per cent. Find his annual income in the two cases. (E.)
19. A sum of £3750 was sold out of the 3 per cents. at 95, and put at compound interest for 2 years at 4 per cent.; the amount was then invested in the $3\frac{1}{2}$ per cents. at 104. Find the alteration in income. (* S. 81.)
20. What capital must be invested in 4 per cent. stock at 91 to bring an annual income of £126, after paying income-tax at the rate of 6d. per £? (* A. 82.)
21. A person invested £1125 in Caledonian Railway stock at £112, 10s. per £100 share; he received a half-year's dividend at the rate of $5\frac{1}{2}$ per cent., and 3 months after the date of purchase realised at £120, 5s. per share. What did he clear after allowing interest at the rate of 5 per cent. on his original capital? († E. 77.)
22. A man invested £8063 in the three per cents. at $98\frac{1}{2}$, the brokerage being $\frac{1}{8}$ per cent.; what will be his clear income after deduction of a tax of 5d. per £? († S. 83.)

23. The Chancellor of the Exchequer proposes to reduce 3 per cent. stock to $2\frac{3}{4}$ per cent. stock, giving a fund-holder the option of being paid off at par, or of receiving £102 of the new stock for every £100 of the old. Find the gain or loss in income by one who chooses to transfer £1000 of the old stock. († E. 84.)
24. The annual dividend on certain shares is at the rate of $12\frac{1}{2}$ per cent. Find accurately to two decimal places the rate at which a man receives interest on the capital he invests, who pays £14 for a £5 share. († E. 86.)
25. Equal sums are invested in 5 per cent. stock at 115, and 9 per cent. stock at £218, 10s., and the difference between the half-yearly dividends is £11. What is the amount invested? (E.)

EXERCISE XV.

RECTANGULAR SURFACES AND SOLIDS.

1. A table-cloth 8 ft. 4 in. by 5 ft. 4 in. is divided into inch squares, and a halfpenny laid on each. How much money will lie on it? (G.)
2. In London a pound note (6 in. \times 4 in.) is said to cover ground equal to its own value. What is the value of an acre? (* A. 80.)
3. A rectangular field is 187 yd. long and 132 yd. broad. Find how many acres it contains, and its yearly value at £2, 5s. per acre. (G. 81.)
4. How many yards of carpet, $\frac{3}{4}$ yd. wide, will be required for a room 24 ft. by 18 ft.? (E.)
5. How many oblong tiles, $4\frac{1}{2}$ in. by $2\frac{1}{2}$ in., are required for a square court, each side of which measures 12 ft. 6 in.? (E.)
6. The top, bottom, and sides of a box which measures 4 ft. in length, 3 ft. in breadth, and 2 ft. in height, are covered with metal at $3\frac{1}{2}$ d. a square foot. Find the cost of the metal required. (E. 84.)

7. Find the cost of painting a box at 1s. 6d. per square yard, whose edges measure 6 ft., 5 ft., and $4\frac{1}{2}$ ft. respectively.
8. A rectangular board 7 in. broad contains 12 sq. ft.; find its length. (E.)
9. A piece of land containing 5 ac. 2 ro. 20 po. has an average breadth of 115 yd. What is its length? (G. 85.)
10. The width of a certain kind of carpet is 2 ft. 11 in. How many yards of it will be required to cover a floor 15 ft. by 14 ft. 7 in.? (S. 78.)
11. A footpath $\frac{1}{4}$ mile in length is laid with gravel at a cost of 5d. per square yard. The whole cost is £13, 15s. Find the width of the path.
12. Find what length of carpet $\frac{3}{4}$ yd. wide will cover a room $26\frac{1}{2}$ ft. by 18 ft., and how much it will cost at 3s. 4d. per yard. (E.)
13. A room 21 feet long requires 49 yd. of carpet $\frac{3}{4}$ of a yard broad. Find the breadth of the room. (E.)
14. How many yards of paper, 30 in. wide, will cover the walls of a room that is 5 yd. square and 9 ft. high?
15. A room is $10\frac{1}{2}$ yd. long by 10 yd. wide, and its height is 8 yd. Find the amount of paper $2\frac{1}{2}$ ft. wide required to paper it. († E. 78.)
16. How many yards of carpet 2 ft. wide will it take to carpet a room 8 yd. by $7\frac{1}{2}$ yd.? If the room be $9\frac{1}{2}$ ft. high, how many cubic feet does it contain? (E.)
17. Find the cost of papering the walls of a room 22 ft. 6 in. long, 18 ft. 9 in. wide, and 11 ft. high; 99 sq. ft. not requiring to be papered, and the paper being 2 ft. 9 in. wide, at 3d. per linear yard. (E.)
18. A schoolroom is 40 ft. long, 26 ft. 6 in. broad, and 19 ft. 3 in. high. If 80 cub. ft. of space and 8 sq. ft. of floor must be provided for each scholar, what is the maximum number of scholars which the room can accommodate? (E.)

19. Find the number of granite blocks required to pave a street 1 mile long and 16 yd. wide, the block being 4 in. broad and 12 in. long. (E.)
20. How many blocks of wood 3 ft. long, 6 in. wide, and 3 in. high, will fill a room 25 ft. long, 15 ft. wide, and 10 ft. high? (E.)
21. Find the number of gallons of water that would cover an acre of ground to the depth of an inch, supposing a gallon to contain $277\frac{1}{2}$ cub. in. (E.)
22. A cub. ft. of water becomes 1.089 cub. ft. of ice. How many cub. ft. of water could be got from an iceberg 660 ft. long, 154 ft. high, and 96 ft. broad? (E.)
23. A cistern 6 ft. long, 4 ft. wide, and 8 in. deep, is filled with pulp for making paper. If half of the pulp be lost in the drying process, find the length of the sheet of paper $\frac{1}{2}$ of an in. thick and 10 in. wide. (E.)
24. A cub. ft. of water weighs 1000 oz. avoirdupois. The weight of water in a rectangular cistern 16 ft. long and $10\frac{1}{2}$ ft. wide is $28\frac{1}{2}$ tons. Find the depth of the water.
25. A room measuring 19 ft. by 17 ft. is to be carpeted so as to leave an uncovered piece next the walls 18 in. broad all round the room. How many square yards of carpet will be required? and how many yards of tape to bind it? (S. 79.)
26. Carpets cost 5s. 9d. per yard, and are $\frac{3}{4}$ yd. wide. What will be the cost of carpeting a room 23 ft. by 22 ft.? How much will be saved by leaving a border uncovered 2 ft. wide all round? (* E. 79.)
27. A carpet 13 ft. 6 in. by 10 ft. 9 in. is laid on a floor 20 ft. 6 in. by 12 ft. 9 in. Find the cost of staining the rest of the floor at 3d. per square yard. (* G. 85.)
28. Find the distance traversed in ploughing 15 ac. of land, when the furrow is cut 11 in. broad; also the time required when the average speed of the plough is $\frac{3}{4}$ mile per hour. (E.)

29. The length of a room is 21 ft., and its height 10 ft. 6 in., and the area of the floor is $\frac{5}{11}$ of the area of the four walls. Find the breadth of the room. (E.)
30. A closed vessel formed of metal 1 in. thick, whose external dimensions are 8 ft. 3 in., 6 ft. 4 in., and 4 ft. 5 in., weighs 7 cwt. 1 qr. 9 lb. What is the weight of a solid mass of the same dimensions? (E.)

EXERCISE XVI

SQUARE ROOT AND CUBE ROOT.

1. Extract the square root of 327184. (E.)
2. Extract the square root of 452929. (* E. 76.)
3. Extract the square root of 33.1776. (* A. 80.)
4. Extract the square root of 1.0101255025. (* A. 84.)
5. Extract the square root of .0009036090108081. (* S. 86.)
6. Find the square root of
(1) 9030025; and (2) $200\frac{25}{8}$. (E.)
7. Find the side of a square whose area is 14 square feet, 9 square inches. († S. 82.)
8. Find the square root of .018225, and of ~~1642~~ 1721. (* S. 80.)
9. A square metre contains 1550.0549 square inches; find correct to two decimal places the number of inches in a metre.
10. Find square root of .02819041; $8\frac{1}{8}$; $25\frac{9}{11}$. (* S. 84.)
11. Extract the square root of .9 to three places of decimals. (* S. 82.)
12. Find the value to three decimal places of $\sqrt{2} + \sqrt{3}$.
13. Find the square root of 7.7 and 77.7 to three places of decimals. (* S. 81.)

14. Find correct to four places of decimals the number of feet in the side of a square field containing 97643.962 square yards. (* S. 78.)
15. Find the square root of $\frac{17}{18}$ correct to the first 5 places of decimals. (* A. 82.)
16. Find to three decimal places the value of

$$\sqrt{\frac{136.95}{.0000249}} \div 1.1. \quad (* S. 85.)$$

17. Find to the nearest foot the side of a square field containing 12 acres.
18. Find to four places of decimals the square roots of $\frac{5}{8}$ and $1\frac{3}{8}$, and multiply the two results together. (* S. 83.)
19. Find the square root of the sum of the squares of .3, .6, .07, and .003. († S. 85.)
20. Find the square root of 5 and the square root of 7 each to three decimal places.
Deduce from them the square root of 35. (E.)
21. A farm in the form of a square contains 400 acres; what is the length of a side expressed in terms of the mile? (E.)
22. A wire-fence with 5 wires encloses a square field containing 18906.25 square yards. Find the length of the wire.
23. Extract the square root of .75 to three places of decimals. If the area of a square be $\frac{3}{4}$ of a yard, what is the length of the side in inches? († E. 75.)
24. It costs £21, 1s. 10½d. to pave a square court-yard at the rate of 1s. 10½d. per square yard. Find the circuit of the court-yard in feet.
25. The area of a square field is $\frac{1}{11}$ of $\frac{5}{8}$ of an acre. Find the number of feet in its side. (G.)
26. Extract the square root of 196.425.
Extract the cube root of 633839779. (E.)
27. Find the square root of 3 to five places of decimals.
Find the cube root of 543338496. (E.)

28. Find the square root of 375468129.
Find the cube root of 163667323. (E)
29. Find the cube root of 12812904.
Find to five decimal places the square root of 7. (E)
30. Find the cube root of 5849513501832. († S. 85.)

EXERCISE XVII.

MISCELLANEOUS EXAMPLES.

1. Define a *prime* number. Write down the first ten primes. (E.)
2. If 3 ducks be worth 4 chickens, and 2 geese be worth 7 ducks, find the value of a goose when a pair of chickens can be bought for 3s. 9d. (E.)
3. What is the proportion between one ounce troy and one ounce avoirdupois? (E.)
4. Ten layers of apples are packed in a box, each layer numbering 75 apples; find the value of the whole at 3 for 2d.
5. A lends B £2500 for 4 months. For how many months should B lend A £1500 in return, the rate of interest being one-third higher? (E.)
6. What is the meaning of 16, $2\frac{1}{2}$, 3.7? († E. 76.)
7. A, who walks at the rate of $3\frac{3}{4}$ miles per hour, starts 18 min. before B. At what rate must B walk to overtake A at the 9th mile-stone? (E.)
8. A grocer mixes tea at 4s. per lb. with tea at 3s. per lb., and by selling the mixture at 3s. 6d. per lb., gains 5 per cent. Find in what proportion he mixes them. (* A. 82.)
9. Find the simple interest on £357, 9s. for 3 years at $3\frac{1}{8}$ per cent. (E.)
10. If 3 men or 5 women can do a piece of work in $9\frac{1}{2}$ days, in how many days will 10 men and 15 women do the same?

11. The price of a certain article, including duty of 5 per cent., is £5. Find the untaxed price. (* A. 83.)
12. Find as a decimal the average of the following:
12.75, $11\frac{5}{8}$, 0, $3\frac{1}{8}$, $25\frac{3}{8}$, $11\frac{1}{2}$, 17.875, and 4.25.
13. Find correct to six places :
 $\frac{3}{4}$ of 15.3125 + .0125 of 11.125 - $\frac{2}{3}$ of .006375.
14. A can do a piece of work in 10 hours, B in 15 hours ;
in what time would A and B do it working
together? (* G. 78.)
15. Find the sum of 1, 22, 333, 4444, 55555, 666666,
7777777, 88888888, 999999999. (E.)
16. Find how many bars, each 20 ft. long, $2\frac{1}{2}$ in. broad,
and .24 in. thick, can be formed out of a piece of
iron containing 3 cub. ft. (* A. 85.)
17. A grazier purchases 11 sheep at £2, 10s. each, 12 sheep
at £2, 15s. each, and 17 sheep at £3, 5s. each ; find
the average price per head.
18. In 100 yd., A beat B by 5 yd. and C by 10 yd. ; by
how many yards will B beat C? (E.)
19. If 76 francs are worth £3, and 1 franc contains 100
centimes, reduce £10, 13s. 9d. to francs and
centimes. (E.)
20. What is a prime number? Write down the prime
numbers between 120 and 140. (E.)
21. Simplify $\frac{.172 \times .172 - .078 \times .078}{.172 - .078} + \frac{1}{1.3}$.
22. Extract the square root of 75.358, giving the answer
correct to five places of decimals. († G. 81.)
23. A sum of £29 is to be divided among 100 workmen,
so that some may receive 5s. 6d. and others 6s. 6d.
How many will receive the larger sum? (* G. 85.)
24. Find at what time between 11 and 12 o'clock the
hands of a watch are at right angles to each other,
explaining clearly the process by which you arrive
at your result. (* A. 81.)

25. A can do $\frac{3}{4}$ of a piece of work in 5 days, and B $\frac{2}{3}$ of it in 4 days: in what time would A and B together do the piece of work?
26. An express train, running 50 miles an hour, leaves Edinburgh for London at 10.20 p.m. When will it reach London, the distance being 405 miles?
27. A box 5 ft. long, 3 ft. wide, and 2 ft. deep, contains 250 oranges; how many will fill a box 4 ft. square and $1\frac{1}{2}$ ft. deep?
28. Taking a centimetre at $\frac{3}{8}$ of an inch, find the number of centimetres in 30 yd. $3\frac{3}{4}$ in. (E.)
29. An excursion party consists of 36 first class passengers paying 2d. a mile, and 210 third-class passengers paying 1d. a mile. The total amount of the fares is £29, 7s. 6d. Find the length of the journey.
30. Explain the notation of decimal fractions, and deduce from your explanation the rule for converting a terminating decimal into a vulgar fraction. (S. 78.)
31. At what time between 4 and 5 o'clock is the minute-hand of a clock 16 minute-divisions in advance of the hour-hand? (* G. 86.)
32. A vessel containing 384 gallons is filled by 3 pipes; the first and second together fill it in 32 min., the first and third in 24 min., the second and third in 16 min. How many gallons does each pipe discharge in a minute? († S. 81.)
33. A tax of 5d. in the £ is paid on a certain sum, and a further tax of $1\frac{1}{4}$ per cent on the remainder. There remains £38, 11s. 7d.; find the original sum.
34. Simplify $3.5 - 2.25$ of $3 \text{ qr. } 6 \text{ lb.}$
 $1.75 + 1.625$ of $7 \text{ owt. } 2 \text{ qr.}$ of $4\frac{1}{2}$ guineas.
35. The velocity of light is 186,000 miles per second; express this in metres per second (take 1 metre = 3.3 feet.) (E.)
36. Add together $1.58\dot{3}$, $12.3\dot{6}$, $.157\dot{3}$, and $.628571\dot{4}$.

37. A can do a piece of work in 14 days; B works twice as fast as A; C can do it in 10 days. In what time
 . (1) will they all do it; (2) will B and C do it?
 († S. 84.)
38. Find the number of square yards in a plot which measures $6\frac{1}{2}$ yd. by $5\frac{1}{2}$ yd. What fraction is this of an acre?
 (E.)
39. Find a fraction intermediate in value to $\frac{5}{8}$ and $\frac{6}{7}$, whose denominator is 84.
 (E.)
40. Two trains, whose lengths are 26 and 24 yd., travel at the rate of 20 and 30 miles per hour respectively. Find the time they will take to pass each other when they move (1) in the same direction, (2) in opposite directions.
 († E. 81.)
41. Arrange the following in ascending order of magnitude:
 $\frac{5+4}{7+5}$ $\frac{5-4}{7-5}$ $\frac{5 \times 4}{7 \times 5}$ $\frac{5-4}{7-5}$
42. A person has £3750 of 3 per cent. stock; how much $3\frac{1}{2}$ per cent. stock must he purchase so that his annual income from the two investments may be £200?
43. From 1861 to 1871 the population of a town increased one-tenth, and from 1871 to 1881 it increased one-tenth. Find what fraction of itself it increased from 1861 to 1881, and what its population was in 1881, if in 1861 it had a population of 18,600. (A. 82.)
44. One-half of the population of one village is equal to three-sevenths of the population of another village. If the population of the latter is 637, find that of the former.
 (A. 83.)
45. A person on being asked what time it was, answered that the time past noon was three-fifths of the time till midnight. What was the time? (E.)
46. Find the difference between the true discount and the banker's discount on £2805, due 6 months hence, at 4 per cent.

47. Find a vulgar fraction which shall represent within the hundred thousandth part the diagonal of a square whose side is unity. (* S. 79.)
48. How many minutes were there in the decade beginning with 1st Jan. 1871? How many minutes less were there in the preceding decade?
49. A thaler is equivalent to 3 shillings, 25 thalers to 93 francs, and 62 francs to 25 gulden. How many gulden are there in £5? (E.)
50. Divide £2064 between A, B, C, and D, so that
 A's share : B's share :: 3 : 4,
 B's " : C's " :: 5 : 6,
 and 8 times D's share = 9 times C's share.
51. A bankrupt owes three creditors £525, £630, and £795, and his assets are £422, 10s.; how much ought each to receive, supposing that the trustee gets 5 per cent. for winding up the bankrupt's affairs? (E.)
52. The rain-fall for the first 8 weeks of the year was 1.08, 2.95, 3.15, .72, .15, 1.34, 1.07, and .93 inches. Find the average weekly rain-fall for the period.
53. A and B walk over the same course from opposite sides. A walks at the rate of $3\frac{3}{4}$ miles an hour, and B 4 miles an hour. They meet $\frac{1}{4}$ of a mile before A reaches half-way. Find the length of the course. († E. 80.)
54. In running a race one mile long, A beats B by 100 yd., and B beats C by 90 yd.; by how much will A beat C? (E.)
55. A shopman's drawings for the first five days of the week are £5, 7s. 3d., £4, 18s. 7d., £6, 11s. 9½d., £6, 5s. 7½d., and £6, 16s. 5d. How much must he draw on Saturday that his average daily drawings may be £7 1.
56. When is the square root of a quantity greater than the quantity itself? (E.)
57. Prove that $765 = \frac{765 - 7}{990}$. (* A. 86.)

58. Simplify $\cdot 83$ of 12s. 6d. — $\cdot 285714$ of 18s. $11\frac{1}{2}$ d.
 $\cdot 6$ of 9 half-crowns
59. For how much must a ship worth £9800 be insured at 8 per cent., so that the premium as well as the value of the ship may be recovered in case of loss. (E.)
60. A farmer buys 2 fields at the same rate per acre, but one field is $\frac{1}{2}$ of the other, and costs £900 less. What did he pay for each field?
61. Two persons, one walking at the rate of 3 miles an hour, and the other $3\frac{1}{2}$ miles an hour, start at the same instant from places $29\frac{1}{2}$ miles apart, and walk towards each other. Find how long it will be before they meet, and how many miles each travels.
 (G. 81.)
62. A property was sold for £8963; the owner received £8626, 17s. 9d. What rate per cent. did the agent receive for commission?
 (G.)
63. Find a fourth proportional to $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$; add to it a fourth proportional to $\frac{1}{7}$, $\frac{1}{8}$, and $\frac{1}{9}$; and give the sum in its lowest terms.
 (E.)
64. On a stream the station B is intermediate to and equidistant from A and C; a boat can go from A to B and back in 3 hours 45 minutes, from A to C in 5 hours 15 minutes. How long would it take to go from C to A?
 († E. 76.)
65. Simplify $\frac{\sqrt{015625}}{\sqrt{64}} \times \sqrt{11025}$.
66. What is meant by the n^{th} power of a number? Prove by taking all the digits from 0 to 9 that the 5th power of any number whatever must end with the same right-hand digit as the number itself.
 (* A. 81.)
67. A field measures 3125 links by 2250 links. Find its area in acres. (100 links = 22 yd.)
68. State and explain every step in the addition of vulgar fractions.
 († S. 81.)

69. Find the compound interest on £12,500 for $2\frac{1}{2}$ years at 4 per cent.
70. Of the 840 candidates at an examination, $\frac{3}{4}$ were boys, and $\frac{1}{3}$ of the candidates failed to pass. How many boys must have passed? and what is the greatest number of boys who can have passed? (E.)
71. A sum of £547, 10s. was lent on March 10th, and £552 was received on May 29th as payment of principal and interest. What rate of interest was allowed?
72. Reduce 15 francs per kilogramme to pence per lb., when the rate of exchange is 25.1 francs per £, and 1 kilogramme = 2.2 lb. (E.)
73. A person has 13 hours at his disposal; how far may he ride in a coach which travels at the rate of 6 miles an hour, so as to return home in time, walking back at the rate of 3 miles an hour? (E. 79.)
74. Show that $\frac{.123}{.41} = \frac{123123}{414141}$. (E.)
75. Reduce 5.46740 to a vulgar fraction in its lowest terms, and *prove your rule* for this case. (E.)
76. A town of 241,000 inhabitants is supplied with water at the rate of 25 gal. per head per day; find the total supply both in volume and in mass for one week. (A gallon of water measures .16 cub. ft. and weighs 10 lb. avoirdupois.) (E.)
77. The market price of a certain article has risen 50 per cent. during the last 30 years, but the value of money has fallen 25 per cent. Find the actual increase per cent. in the value of the article. (* A. 82.)
78. Two trains, whose lengths are 180 yd. and 240 yd., travel at the rate of 48 miles and 40 miles per hour respectively. How long will they take in passing each other:
- (1) when they move in the same direction?
 - (2) when they move in opposite directions?
- (E.)

79. I invest £4750 in the 3 per cents. at 95, and on receiving a half-year's dividend, I sell out. The total increase on my original capital is £200; at what price did I sell out?
80. A walks $4\frac{1}{2}$ miles per hour, but starts 2 hours after B, who walks only $3\frac{1}{2}$ miles per hour. Find when and where A will overtake B, supposing them to start from the same place, and to walk along the same road. (* G. 82.)
81. The first *six* candidates in a competitive examination gain 90.83 per cent. of marks, and the first *seven* 90 per cent. Find the percentage gained by the seventh.
82. Giving the rate of exchange as 25.22 francs per pound sterling, and that 4.54 litres are equivalent to one gallon, deduce the number of francs per litre equivalent to one shilling per gallon. (* E. 84.)
83. If 1 sq. metre = 1.19603 sq. yd., find how many cub. metres there are in 354 cub. yd. 3 cub. ft. († E. 77.)
84. In four selected weeks in a year, the deaths in a city of 140,000 inhabitants are 125, 85, 110, and 100 respectively. Find the annual number of deaths at the same rate per 1000 of the inhabitants. (E.)
85. A, walking at $3\frac{1}{4}$ miles per hour, starts $2\frac{1}{2}$ hours before B, who walks along the same road at $4\frac{1}{2}$ miles per hour. When will B overtake A, and how far will each have gone? († S. 82.)
86. A gardener plants an orchard with 7225 trees, and arranges them so that the number of rows of trees equals the number of trees in each row. How many rows are there? (E. 73.)
87. Explain the notation of vulgar fractions, and show that the value of a vulgar fraction is unaltered by multiplying both its numerator and denominator by the same number. (* S. 79.)

88. The penny is one-tenth of a foot in diameter, and weighs one-third of an ounce; the halfpenny is an inch in diameter, and weighs one-sixth of an ounce. What is the relative average thickness of the two coins? (E.)
89. A rectangular field is 180. yd. long and 75 yd. broad. A and B start from the same corner, A to walk round the field, B to walk to the opposite corner and back. Which will reach the starting-point first, if their rates of walking are as 4 to 3?
90. A watch that gains 24 seconds per hour is set to right time at 4.45 P.M.; what will be the right time between 8 and 9 o'clock the same evening, when the hour and minute hands of the watch point in exactly opposite directions? († S. 81.)
91. A reduction of 25 per cent. in the price of oranges enables a fruiterer to receive 120 more oranges for a sovereign. Find the original price.
92. A, B, and C run a race for a mile. B has one minute start, and C two minutes on A. The actual pace of each is: A, 10 miles an hour; B, $8\frac{1}{2}$ miles an hour; C, $7\frac{1}{2}$ miles an hour. Who wins, and who loses? and how long after the winner does the last man pass the winning-post? († E. 79.)
93. An express train leaves A at 2.30 and reaches B at 4.10. An ordinary train leaves B at 2.55 and reaches A at 5.15. When do they meet? (* S. 86.)
94. I have to reach a certain place at a certain time. If I walk 3 miles an hour, I shall be 20 min. late; if 4 miles an hour, I shall be 30 min. too soon. How far have I to walk?

95. Reduce $\frac{\sqrt[2]{1.89} - \sqrt[2]{.56}}{\sqrt[2]{8.76} - \sqrt[2]{4.48}}$ to its simplest form.

(† E. 79.)

96. In a certain town, the number of children under 5 years of age who died in a month was 135. This was 36 per cent. of the total deaths for the month, and the death-rate, that is, the number of deaths per thousand inhabitants in a year, was 17.62. What is the estimated population? (* S. 86.)
97. Reduce to a single decimal :
- $$\frac{.7396}{2.047} \times \frac{4.732}{.791} \times \frac{2.7}{3.5462} \quad (\dagger \text{ E. } 76.)$$
98. The census of 1881 gives the population of a town as 51,058, while in 1871 it had 46,715 inhabitants. What is the average increase per cent.? If the population of this town continue to increase at the same rate, what will it be in 1883? (\dagger S. 81.)
99. A person sold a horse so as to gain $12\frac{1}{2}$ per cent. Had he bought him for £4 more and sold him for £6 less, he would have lost $2\frac{1}{2}$ per cent. What did he pay for the horse? (* A. 84.)
100. The year 1879 began on a Wednesday; on what day of the week will the nineteenth century end, and how many times in the course of the twentieth will New Year's Day fall on a Saturday? (* S. 79.)

EXERCISE XVIII.

ADDITIONAL EXAMPLES.

(a) *Questions set in Entrance Examinations and Examinations for Bursaries.*

1. A number on being divided by 57 gives quotient 17 and remainder 23. What is it? (A.)
2. A grocer buys 10 cwt. 3 qr. 21 lb. of sugar for £30, and pays 12s. 6d. for expenses. At what rate per lb. must he sell it to clear £15, 6s. 3d. by his bargain? (G.)
3. One side of a square room is $19\frac{1}{2}$ ft. Find (1) the size of the floor, and (2) the expense of carpeting it with carpet 4 ft. 4 in. wide at 3s. 6d. per yard. (G.)

4. Divide the sum of $\cdot 6$ and $\cdot 296$ by their difference.
(S.)
5. An engineer's plant depreciates at the rate of 10 per cent. per annum. If it costs £2000, at what price ought it to be valued at the end of three years?
(G.)
6. Reduce 4s. $2\frac{1}{2}$ d. to the decimal of 5s. 11d., and divide the result by $\cdot 0014$.
(E.)
7. A lends B £400 for 15 months, at 4 per cent. How long should B lend A £1500 at 3 per cent. in return?
(G.)
8. Goods which originally cost £30, 8s. 4d. for 2 tons 7 cwt. are sold at a gain of $17\frac{1}{2}$ per cent. Find the selling price per cwt.
(G.)
9. Reduce to its simplest form :

$$\left(\frac{1\frac{1}{2}}{2} - \frac{1\frac{1}{2}}{3}\right) - \left(\frac{1\frac{1}{2}}{4} - \frac{1\frac{1}{2}}{5}\right)$$

(G.)
10. Find the value of $\cdot 0015740$ of £810.
(A.)
11. Find the value of

$$(a) 6\frac{7}{8} + 1\frac{5}{8} \div \frac{8}{18} - \frac{1}{7};$$

$$(b) 6\frac{7}{8} + 1\frac{5}{8} \div \left(\frac{8}{18} - \frac{1}{7}\right);$$

$$(c) (6\frac{7}{8} + 1\frac{5}{8}) \div \frac{8}{18} - \frac{1}{7}.$$

(A.)
12. Multiply 12 tons 1 cwt. 10 lb. by 94.68.
(A.)
13. I bought 145 quarters of wheat at 50s. per quarter, and in selling it I made a profit of £36, 5s. How much per cent. was the profit?
(G.)
14. If £26, 3s. 3d. be distributed between 5 men and a boy, and if the boy receive half a man's share, and each receive a whole number of pence, how many pence will remain undivided?
(A.)
15. A man owns $\frac{3}{4}$ of a ship. She returns at the end of a season and pays her owners 7 per cent. He receives £105. What is the value of the ship?
(A.)
16. Divide 728.2698503 by $\cdot 01972$, so far as to obtain the integral part of the quotient.
(A.)

17. A sum of money is put out to compound interest at 4 per cent., and the third year's interest is £73, 4s. 8d. Find the first year's interest. (G.)
18. Find the expense of painting the walls of a room 48 ft. long, 24 ft. broad, and $10\frac{1}{4}$ ft. high, at $10\frac{1}{4}$ d. per square yard. (G.)
19. At what two moments between 5 and 6 o'clock are the hands of a watch separated by 15 minute-spaces? (G.)
20. Find the cube of .14, and then take the square root of the result to five places of decimals. (S.)
21. If by selling at 1s. 5d. per lb. a profit of 26 per cent. is made, what was the cost per cwt.? (S.)
22. In what proportion must I mix spirits worth 15s., 16s. 6d., and 18s. 6d., if the mixture is to be sold at 17s. 6d. per gallon, with a profit of 5 per cent., the quantities employed of the first two being equal? (S.)
23. Find the square root of $\frac{.00125}{.18}$. (S.)
24. Find the value of $\frac{1\frac{7}{8} + \frac{2}{3}}{3\frac{4}{8} - \frac{2}{3}}$ of £5 + $2\frac{2}{3}$ of $1\frac{1}{3}$ of $\frac{1}{7}$ of 5s. 3d. + .428571 of £2, 9s. $10\frac{1}{2}$ d. (S.)
25. A room 27.7 ft. long, 19.55 ft. wide, and 12.4 ft. high, is hung with paper 2.7 ft. wide. What will it cost at 1s. 3d. per yard? (S.)
26. To pay off a debt in a certain number of years, £63, 12s. 6d. has to be raised for every £1000 of debt. An assessment of 1d. per £ of rental brings in £130. Find to the nearest penny the assessment required to pay off a debt of £18,000. (S.)
27. In Paris a sovereign is worth 25 francs 10 centimes, and in London a 20-franc piece is worth 15s. 3d. What is gained or lost by changing 100 sov. in Paris, and changing their French equivalent back into English money in London? (S.)

28. Add the product of 2.83 by .0013 to the quotient of 9.6195 by 847. (S.)
29. A man increases his capital by 25 per cent. annually. At the end of 3 years it is £2441, 8s. 1½d. What was it originally? (S.)
30. For how much must a ship, worth £20,000, be insured at 10 per cent., so that the premium as well as the value of the ship may be recovered in case of loss? (S.)
31. By selling at 6s., 12 per cent. is lost. What price will give a gain of 10 per cent.? (S.)
32. The lineal decimetre is 3.937 inches. The litre is the cubic decimetre. Express the litre as the decimal of a cubic foot. (E.)
33. Divide £294, 14s. 5½d. among 6 men and 9 boys, so that each man may have double what each boy has. (A.)
34. A man bought a horse for £40, and immediately exchanged him for a bill of £47, 5s. payable at the end of six months. Allowing for the use of money at 10 per cent., what is his gain per cent.? (G.)
35. Find the value of $\frac{3\frac{3}{10} - (1\frac{1}{2} \text{ of } \frac{3}{8})}{\frac{4\frac{1}{2}}{8} + 2 + 1\frac{3}{10}}$ of $2\frac{1}{2}$ guineas. (G.)
36. If 114 men can do $\frac{2}{3}$ of a piece of work in 9 days, how many days will 18 men require to do $\frac{5}{12}$ of the same piece? (A.)
37. Find—without actually turning $\frac{1}{17}$ into a decimal—(1) whether it will be a terminating or a recurring decimal; and (2) if the latter, what is the greatest number of figures the period can possibly have? (A.)
38. A man starts on a journey, walking 4 miles an hour, but afterwards gets a lift in a carriage going at 10 miles an hour. He is out 6 hours, and accomplishes 38 miles. How many of these did he walk? (A.)

39. A person having £2200 in the 3 per cents., sells out at $99\frac{1}{2}$, and buys Indian 4 per cents. at 102. Find the change in his income. (S.)
40. Add together $\frac{4\frac{4}{5} - \frac{1}{8}}{3\frac{3}{4} - \frac{9}{20}}$ of £1, 13s. and .0125 of $1\frac{1}{2}$ of £4, 10s. (A.)
41. Why is it that a number is divisible by 4 without remainder, if the number formed from it by taking the two figures to the extreme right is divisible by 4? (A.)
42. A grocer mixes tea of a certain quality (A) with $\frac{2}{3}$ of its weight of tea, which cost him half as much, and sells the whole at $\frac{5}{8}$ of the price of (A) per lb. What percentage of profit has he on his outlay? (A.)
43. An express train leaves Glasgow for Edinburgh at 8.50 P.M., arriving at 10.5 P.M. A slow train, taking two hours to the journey, leaves Edinburgh at 8.5 P.M. At what time may they be expected to meet? (G.)
44. Extract the square root of 35 and of .00035 to four figures each. (S.)
45. Find the amount of £8000 at 5 per cent. compound interest in 5 years. (S.)
46. In a mile race A can beat B by 56 yd., or $8\frac{1}{2}$ seconds. Find A's time to the mile. (S.)
47. After paying income-tax at 5d. per £, and other taxes at the rate of 2s. 9d. per £ on his rent of £80, A has £642, 7s. 10d. left. What is his gross income? (S.)
48. A sum of £418, 17s. 9d. is to be paid to 33 people. Four of them are to receive £10, 17s. $3\frac{1}{2}$ d. each, and what remains is to be divided equally among the other 29. How much will each get? (A.)
49. Simplify $\frac{187 - \frac{17}{11}}{187 + 187 \times \frac{1}{3}} + \frac{203 + 203 \times \frac{7}{12}}{203 + \frac{29}{3}}$. (A.)
50. Express 14 cwt. 1 lb. 5 oz. (avoir.) in quarters and decimals of a quarter. (A.)

51. If a shopkeeper uses a false weight of $15\frac{7}{8}$ oz. for the lb., what will a true cwt. appear to weigh? (E.)

52. Calculate the value in lb. avoird. of

$$\left. \begin{array}{l} \frac{34}{12} - \frac{25}{24} - \frac{23}{24} - \frac{12}{28} \\ \frac{23}{24} - \frac{12}{28} - \frac{12}{28} - \frac{1}{12} \end{array} \right\} \text{ of 149 cwt. 1 qr. 24 lb.}$$

(A.)

53. Two clocks are together at 12. When the first again comes to 12, it has gained a minute; and when the second comes to 12, it has lost a minute. When will the clocks be a quarter of an hour asunder?

(E.)

54. The wheel of a bicycle is 4 yd. 1 ft. 4 in. in circumference. How often will it revolve in 100 miles?

(A.)

55. Explain accurately the meaning of the following: Prime number, factor, divisor, measure, multiple. Resolve 5005 into its prime factors.

(A.)

56. A man took 17 hours to go from one place to another at the rate of $3\frac{1}{4}$ miles an hour. How long would he have taken had he gone at $5\frac{2}{3}$ miles an hour?

(A.)

57. Simplify $\frac{3}{13} \times \frac{.39}{23} \times \frac{161}{.019} - \frac{2}{17} \times \frac{13}{7} \times \frac{406}{2.9}$.

(A.)

58. Find the value of .037 of 6 tons 9 cwt. 24 lb. at £2, 16s. 7d. per cwt.

(A.)

59. A room is in the form of a cube, being equally long, broad, and high. The area of the floor is 50 sq. ft. Find the cubic content correct to one decimal place in cubic feet.

(A.)

60. If the proportion of deaths be annually 1 in 56 in towns, and 1 in 45 in the country, what is the percentage of mortality when the town population bears to that of the country the proportion of 3 to 7?

(E.)

61. Extract the square root of $1\frac{1}{2}$, and the cube root of 4 feet 1088 inches cubic measure.

(E.)

62. A and B run a race $\frac{2}{5}$ of a mile on a course $\frac{1}{5}$ of a mile in circumference; they run in opposite directions, and A wins by 64 yd. Where was B when
 (1) A passed the post the first time;
 (2) A passed B the second time? (S.)
63. Divide £1750 between four persons, so that their shares shall be as the fractions $\frac{2}{7}$, $\frac{3}{14}$, $\frac{1}{4}$, $\frac{1}{12}$. (E.)
64. The dividend on the shares of a bank is announced to be 10 per cent. clear of income-tax. What is the real dividend, income-tax being 4d. in the £?
 (E.)
65. Find the prime factors of 26381, it being known that all of them are between 20 and 40. What is the nearest number to 26381 which has a common measure with it consisting of a whole number other than unity?
 (A.)
66. Two bicyclists ride round a circular path in the same direction; one of them travels 20 miles an hour, and the other 15 miles an hour, and the slower is passed by the quicker every 10 minutes. How often would they meet each other if they went round in opposite directions? and how far is it round the path?
 (G.)

(b) *Questions set at Edinburgh University in M.A. Pass Examinations.*

1. A dollar is worth 4s. $4\frac{1}{2}$ d., and a rupee 2s. $0\frac{1}{2}$ d. Find the least number of rupees which makes an exact number of dollars.
2. A kilogramme = 2.046 lb. avoird. Express a lb. troy in grammes.
3. A woman bought eggs at 2 a penny, as many more at 3 a penny, and then again as many more at 4 a penny. She sold them all at the rate of 5 for 2d., and gained 7d. How many did she buy each time?

4. A man contracts to perform a piece of work in 60 days, and immediately employs upon it 30 men; at the end of 48 days the work is only $\frac{2}{3}$ th done. Required the additional number of men necessary to fulfil the contract.

5. Reduce to its simplest terms :

$$\left\{ \frac{2\frac{1}{4} - \frac{2}{3} \text{ of } 1\frac{5}{6}}{\frac{1}{8} \text{ of } 3\frac{1}{3} + \frac{1\frac{3}{8}}{8}} - \frac{1}{2\frac{1}{2}} \right\} \div \frac{5\frac{1}{4}}{8\frac{3}{4}}$$

6. Reduce to its simplest form :

$$\frac{3\frac{1}{2} + 2\frac{5}{6}}{3\frac{1}{2} - 2\frac{5}{6}} + \frac{3\frac{1}{2} \text{ of } 3\frac{1}{7}}{3\frac{1}{2} \div \frac{7}{11}} - \frac{9\frac{1}{3}}{7}$$

7. A takes a house for 12 months at a rent of £144. After 3 months he admits B as a co-tenant, and they, in like manner, admit C for the last $3\frac{1}{2}$ months. How much of the rent should each of them pay?
8. A person paid in income-tax £26, 0s. 10d., but when the tax was raised by 2d. in the £, he paid £36, 9s. 2d. Required his gross income and the rate of income-tax.
9. A bag contains sixpences, shillings, and half-crowns. The three sums of money expressed by the different coins are the same. If there are 102 coins in the bag, find their total value.
10. Reduce to their simplest form :
- (1) $\frac{\frac{2}{4} \text{ of } 3\frac{1}{2} + \frac{5}{8}}{10 - \frac{11}{18} \text{ of } 1\frac{1}{2}} \div \frac{(\frac{1}{2} - \frac{1}{3})(\frac{1}{3} + \frac{1}{4})}{(\frac{1}{2} + \frac{1}{3})(\frac{1}{2} - \frac{1}{4})}$
- (2) $\frac{10.810 \times 10.2 \times 10.2}{11.3 \times 10.35 \times 9.609}$
11. A can complete a piece of work in 12 days of 8 hours, and B in 7 days of 9 hours. How long will it take both of them to complete the work if they work together at it 6 hours a day?
12. If the number of boys in three classes of a school be in the proportion of 3, 4, and 5, and the percentage of absentees 20, 30, and 36, find the percentage of absentees in the school.

13. A path 3 ft. wide has to be made 4 ft. from the walls round a court measuring 105 yd. by 95 yd. How many square yards will it cover?

14. Express as a single decimal :

$$1\frac{1}{2} \text{ of } 3\frac{1}{4} + .016 + \frac{1\frac{1}{8} - \frac{1}{4}}{2\frac{1}{2} + \frac{1}{8}} + \frac{1.25}{.08}.$$

15. The net rental of an estate, after deducting 7d. in the £ for income-tax, and 5 per cent. on the remainder for the expenses of collecting, is £479, 11s. 10d. What is the gross rental?

16. A ship is valued at £14,720. What sum should be insured at 8 per cent. by a person who owns $\frac{1}{16}$ th of the ship, so that, in case of loss, he may recover both his share of the vessel and his insurance?

17. A, B, and C join in trade; A puts in £1000 for 8 months, B £1500 for 4 months, and C £2000 for 2 months. How ought a profit of £900 to be divided amongst them?

18. What sum will amount to £1000 in 2 years, at 4 per cent. compound interest?

19. A merchant sells his goods at 35 per cent. above cost price. If he allows a customer 5 per cent. on his bill, what profit does he make?

20. Two equal wine-glasses are filled with mixtures of wine and water, in the proportions respectively of 1 : 3 and 1 : 4. When the two are mixed together, what is the strength of the mixture?

21. A square whose side is 146 ft. contains 1980.25 square metres. Find the number of inches in a metre correct to three decimal places.

22. A merchant buys teas as follows : 11 lb. at 4s. a lb. ; 12 lb. at 4s. 3d. ; 13 lb. at 4s. 6d. ; 14 lb. at 5s. ; 16 lb. at 5s. 3d. ; and mixes the whole. If he sells the mixture at 6s. 8d. a lb., what does he gain per cent. approximately?

23. Find the discount on £4120, 8s. 7d., due 9 months hence, interest being reckoned at 4 per cent. per annum.

Does the debtor gain or lose by computing interest instead of discount?

24. Two equal wine-glasses are full, and contain respectively 1 of wine to 5 of water, and 1 of wine to 6 of water. When both are poured into a tumbler, what is the strength of the mixture?

25. What is the equivalent of compound interest at $2\frac{1}{2}$ per cent. per quarter, in terms of per cent. per annum?

26. Find $\sqrt{(20605)^2 - (16484)^2}$.

27. On a certain map a square inch represents 4000 ac. What is the scale of the map?

28. A merchant buys 12,000 bushels of wheat at 8s. per bushel, of which $2\frac{1}{2}$ per cent. is wasted. He sells 24 per cent. of the remainder at 10s. a bushel, 20 per cent. at 8s., and the remainder at 7s. 6d. How much does he gain or lose by the transaction?

29. Reduce to a single decimal fraction :

$$\frac{.04275}{3.05} \times \frac{4.216}{.342} \times \frac{.27}{1.5318}$$

30. A person by selling at 4s. $1\frac{1}{2}$ d. per lb. an article which cost £21 per cwt., cleared 2 per cent. more profit than if he had sold the whole for £162. How much was sold of the article?

31. The population of Scotland at the beginning of 1881 was 3,735,573. If $\frac{1}{11}$ of the population die or emigrate each year, and $\frac{1}{30}$ of the population are born or immigrate each year, what will the population be at the end of 1884?

32. The 3 per cents. were at 89, and the 4 per cents. at 98. The same sum was invested in each, and the difference of the incomes was £62. What was the sum?

33. Extract the square root of 121.2201, and prove that no square number can end with one of the digits 2, 3, 7, or 8.
34. A man rowing with a fixed strength makes 2 miles in half an hour up a river, but when rowing down he accomplishes the same distance in 20 minutes. What is the strength of the current?
35. A fruiterer buys a certain quantity of apples at the rate of 400 for £1, and twice as many at 600 for £1. If he retail them at a halfpenny each, how much will he gain or lose per cent. by the transaction?
36. Two gallons of spirit, which contains 12 per cent. of water, are added to 3 gallons containing 7 per cent. of water, and to the whole is added half a gallon of water. Find the percentage of water in the mixture.
37. For a special sale a merchant gave his customers 40 per cent. off the marked price, but the goods had been marked at an advance of 60 per cent. on their cost. Did he gain or lose, and at what rate per cent.?
38. In shipping ice, 12 per cent. is destroyed, 45 per cent. of the shipped ice melts during the passage, 20 per cent. of the remainder is lost in landing. At what increase per cent. on the original price per lb. must the residue be sold to yield a profit of 142 per cent. on the whole?
39. Find the sum payable 4 months hence, interest being at 2 per cent., which will be equivalent to the two following sums: £422, 12s. 6d., due 3 months hence, at $2\frac{1}{2}$ per cent., and £485, 10s., due 5 months hence, at $2\frac{3}{4}$ per cent.
40. In a mile race, A gives B 50 yd. B passes the winning post 5 minutes after the start, A passes it 5 seconds later. Which would win in an even race, and by what distance?

41. Two trains, A and B, are despatched from opposite termini of a railway at the same time, with speeds of 20 and 30 miles per hour respectively. A third train, C, is despatched after B, three hours later, with a speed of 40 miles per hour. What is the length of the railway if A pass C half an hour after passing B?
42. In 1876 the profits realised by the L. C. and D. Railway Company bore to the expenses the proportion of 13 to 15. In 1877 the gross receipts increased $3\frac{1}{2}$ per cent., while the expenses increased $1\frac{1}{3}$ per cent. Find how much per cent. the profits increased.
43. The radii of two circles are 21.1 ft. and 54.3 ft. respectively. Find to the 5th place of decimals the radius of a circle whose area is the sum of the areas.
44. A merchant bought 200 yd. of cloth at 6s. per yard, payable in 3 months, and sold them one month after at 7s. per yard, payable in 4 months. To pay the purchase-money, he borrowed for the necessary time at the rate of 6 per cent. per annum. Find his gain or loss on the transaction.

SPECIMEN EXAMINATION PAPERS.

I. UNIVERSITY LOCAL EXAMINATIONS.

PRELIMINARY ARITHMETIC.

EDINBURGH, *June 1886.*

1. Multiply 3.0129 by 98.087; and divide .121704498 by .01233.
2. Add together $\frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7}$.
3. Find the G.C.M. of 1805771 and 2307101, and the L.C.M. of 59297, 26789, and 17533.
4. Express in £ s. d. the sum of 384 farthings, 200 pence, 970 four-pennies, 576 half-crowns, 200 crowns, and 321 guineas.
5. How much cloth at 1s. 9d. the yard is equivalent to 5 cwt. 7 lb. of tea at £14 the cwt.?
6. Find the number of acres in a rectangular field 2 miles 88 yd. long, and 3 miles 22 yd. broad. (Express the result in acres and a decimal fraction of an acre.)
7. Show how to divide £97, 7s. 2d. among three persons, A, B, and C, so that A may get twice as much as B, and B twice as much as C.

GLASGOW, *May 1886.*

1. Multiply 89753 by 4386. Divide 9654872 by 6724.
2. Multiply 18 cwt. 3 qr. 6 lb. by 238. Divide £1422, 17s. 3d. by 76.
3. A sovereign weighs 5 dwt. $3\frac{1}{2}$ gr. How many sovereigns may be coined from a mass of standard gold weighing 55 oz. 5 dwt. 11 gr.?
4. Find the sum of $6\frac{1}{2}$, $4\frac{1}{2}$, $7\frac{1}{2}$, $9\frac{1}{2}$. From $\frac{1}{2}$ of $5\frac{1}{2}$ subtract $\frac{1}{4}$ of $5\frac{1}{2}$.
5. Find the product of $2\frac{1}{2}$, $3\frac{1}{2}$, $4\frac{1}{2}$. Divide $13\frac{1}{2}$ by $7\frac{1}{2}$.
6. What fraction of £8, 3s. 4d. is £5, 12s. 6d.?
7. Find the value of 32 cwt. 3 qr. 14 lb. at £2, 12s. 6d. per cwt.
8. If 12 yd. cost £3, 6s. 6d., what will 155 yd. cost?

ABERDEEN, *June 1886.*

1. Express in words 3007019. Subtract Three millions three thousand and six from Five millions.
2. What is meant by *Prime Number*? Divide 7380 by 35, first by Long Division, and then by its factors 7 and 5. Account in any way for the method of finding the remainder in the latter process.

3. Value 9 tons 19 cwt. 3 qr. 14 lb. at £14 per ton.
4. A merchant buys sugar at £1, 10s. 4d. per cwt. He retails it at 4d. per lb. What profit does he make on every 100 lb. that he sells? and what weight of sugar has he sold when he has made a profit of £1?
5. Add together $5\frac{1}{2}$, $8\frac{1}{2}$, $7\frac{1}{2}$, $3\frac{1}{2}$, and subtract $15\frac{1}{2}$ from the sum.
6. Multiply 4.0032 by .005. Divide 1.64 by (a) .0041, (b) 4100.
Reduce to vulgar fractions in lowest terms: .4375, .56, .035.
7. If the cost for carriage of 7 cwt. 1 qr. 10 lb. for a certain distance be £1, 17s. 6d., what will be the carriage of 6 cwt. 13 lb. for double that distance?
8. How many times is 33 po. 24½ yd. contained in 2 ac. 1 ro. 12 po.? Express the first expression as a decimal fraction of the second.

ST ANDREWS, June 1886.

1. Express in words 20304005, and express in figures Sixty-three millions six hundred thousand and three.

$$\begin{array}{r}
 2. \text{ Add} \quad \quad \quad \pounds 432 \ 17 \ 9\frac{1}{2} \\
 \quad \quad \quad \quad \quad \quad 83 \ 5 \ 4\frac{1}{2} \\
 \quad \quad \quad \quad \quad \quad 567 \ 12 \ 10\frac{1}{2} \\
 \quad \quad \quad \quad \quad \quad 949 \ 13 \ 2 \\
 \quad \quad \quad \quad \quad \quad 65 \ 4 \ 11\frac{1}{2} \\
 \quad \quad \quad \quad \quad \quad 297 \ 16 \ 8\frac{1}{2} \\
 \quad \quad \quad \quad \quad \quad \hline
 \quad \quad \quad \quad \quad \quad 78 \ 5 \ 7
 \end{array}$$

3. Multiply £137, 16s. 8½d. by 749.
4. Reduce 17 cwt. 3 qr. 15 lb. 8 oz. to drams.
5. Divide 29 ac. 3 ro. 1 po. 21 yd. by 71.
6. Divide the difference of $\frac{1}{3}\frac{1}{3}$ and $\frac{2}{3}\frac{1}{3}$ by their sum.
7. Find, by Practice, the cost of 285 articles at £1, 8s. 6½d. each.
8. A bankrupt's assets are £218, 3s. 4d., and his liabilities are £1283, 6s. 8d. How much does he pay in the £, and what is the amount of a creditor's debt when his dividend is £42, 10s.?
9. A garrison of 2100 men is provisioned for 9 months. At the end of 2 months, 300 men are killed or taken prisoners. How long can the garrison still hold out?

EDINBURGH, June 1887.

1. Multiply 314.023 by 12.306. Divide 31080.3480 by 304.56.
2. Simplify $\frac{\frac{1}{2} + \frac{1}{3}}{\frac{1}{2} + \frac{1}{3}} + \frac{\frac{2}{3} + \frac{1}{2}}{\frac{1}{2} + \frac{1}{3}} + \frac{\frac{1}{3} + \frac{1}{2}}{\frac{1}{2} + \frac{1}{3}}$,
and express the result as a decimal fraction.
3. Find the G.C.M. of 4047, 14839, and 24495; and the L.C.M. of 156, 665, 228, and 455.

4. Find the sum of 120 guineas, 56 crowns, 260 half-crowns, 710 shillings, 1000 pence, and 600 farthings.
5. If an English sovereign is worth 20.4 marks, find the value in English money of 965 marks.
6. A sum of £21, 10s. is divided among three persons, so that for every penny the first gets, the second gets a shilling, and the third half-a-crown. How much does each get?
7. Half of a man's money yields him 3 per cent., and the other half $3\frac{1}{2}$ per cent. interest. When the rates of interest rise to $3\frac{1}{2}$ and 4 per cent. respectively, his income is increased by £40. What was his original income?

GLASGOW, *May* 1887.

1. How is the value of a figure affected by its position in a number? Write down, separately, the number of units expressed by each figure in the number 1234567.
2. Multiply 56796 by 3287, and divide the product by 69347.
3. Multiply £27, 6s. 8d. by 637. Divide 46 tons 1 cwt. 1 qr. by 134.
4. What is an 'aliquot part' of a number? Write down some of the aliquot parts of £1 and of 1 cwt.
Find, by Practice, the value of 1367 articles at £1, 7s. 10d. each.
5. Write down examples of a simple fraction, a compound fraction, and a complex fraction.
Add together $2\frac{1}{2}$, $4\frac{1}{3}$, $5\frac{1}{4}$, $11\frac{1}{5}$. From $5\frac{1}{2}$ take $3\frac{1}{4}$.
6. Multiply together $3\frac{1}{2}$, $2\frac{1}{3}$, $5\frac{1}{4}$, $2\frac{1}{5}$. Divide $7\frac{1}{2}$ by $\frac{2}{3}$ of $5\frac{1}{4}$.
7. Give the rule for 'stating the question' in proportion.
If the rent of a farm of 125 acres be £200, what ought to be the rent of another, with equal advantages, and containing 168 acres?
If 24 men can execute a piece of work in 65 days, how long will 55 take to do it?
8. A can do a piece of work in 15 days, while A and B working together can do the same amount of work in 8 days. How long would B, working alone, take to do it?

ABERDEEN, *June* 1887.

1. Find the value of 10 tons 13 cwt. 94 lb. at £7, 14s. per cwt.
2. State and illustrate, by taking as an example the numbers 312 and 585, any method of finding the Least Common Multiple of two numbers.
3. What is meant by the Greatest Common Measure of several numbers? Find the G.C.M. of 374976 and 23940.

4. Simplify $\frac{1 + 2\frac{1}{2} + 3\frac{1}{2}}{1\frac{1}{2} + 2\frac{1}{2} + 3\frac{1}{2}} \times \frac{55\frac{1}{2}}{1\frac{1}{2} \text{ of } 13\frac{1}{2}} \div \frac{11}{1}$
5. Find the value of $\frac{.016 \text{ of } 2\frac{1}{2}}{7\frac{1}{2} \div 3\frac{1}{2}}$ of £1. What fraction, correct to four places of decimals, is it of 13s. 8½d.?
6. Multiply .302 by .1006. Divide .497016 by .00216.
7. If 21 men can dig a trench 5 miles long, 7 feet wide, and 3 feet deep, in 220 days; what depth of trench, whose length is 8 miles 480 yards, and width 8 feet, could 16 men dig in 480 days?

ST ANDREWS, June 1887.

- Express in words 69083076, and in figures Eight hundred and four million five thousand seven hundred and sixty-three.
- Add together £67, 12s. 10½d., £283, 6s. 5½d., £47, 17s. 3d., £89, 12s. 6d., £407, 9s. 8½d., £53, 14s. 4½d., £289, 12s. 11d., £55, 15s. 5½d.
- Multiply £63, 17s. 5½d. by 372.
- Divide 13 tons 8 cwt. 2 qr. 5 lb. by 83, and in the answer substitute for the resulting fraction of a pound whichever of the following fractions is most nearly equal to it: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{4}$.
- Reduce 500,000,000 inches to miles.
- Reduce 8 ac. 3 ro. 5 po. 4 sq. yd. to sq. inches.
- What number is that $\frac{2}{3}$ of which is 34 times 45?
- What fraction is $2\frac{3}{4}$ of $1\frac{1}{2}$?
- When the leaves of a new book have to be cut, the first 8 pages require 1 cut, the next 8 pages require 3 cuts, and so on alternately, with successive portions of 8 pages each. In a book of 372 pages how many cuts are necessary?
- A man bought a piece of silk containing $96\frac{3}{4}$ yards. Having used $\frac{2}{3}$ of it, he sold $\frac{1}{3}$ of the remainder at $1\frac{1}{2}$ dollars per yard, and the remnant at $\frac{1}{2}$ of a dollar per yard. Find in dollars the value of the silk sold; and if each dollar is worth $4\frac{1}{2}$ shillings, find the value in sterling money.

EDINBURGH, June 1888.

- Convert the following vulgar fractions to decimals, and then add them together: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$.
- Multiply 20801.307 by .0213. Divide 200000 by 3.14159 to two places of decimals.

3. Find the total value of the following :

250 articles at £1	3	9	each,
480	"	0	0 5½ "
200	"	0	2 7 "
and 27	"	1	13 4 "

4. Add together the following, expressing the result as a vulgar fraction in its simplest form : $11\frac{2}{77} + 10\frac{3}{77} + 33\frac{1}{77} + \frac{4}{77}$.
5. If a tennis-court measures 78 feet by 38, find how much ground will be occupied by 10 courts (neglecting any space there may be between the courts). Express the result as a decimal fraction of an acre, to three places of decimals.
6. A man buys a thousand pounds' worth of goods, and gets a thousand pounds again by selling a certain quantity at a gain of 10 per cent. He clears off the remainder at a loss of 5 per cent. How much does he gain on the whole transaction?
7. A, B, and C are travelling together. A pays a hotel bill amounting to 105 francs, B another amounting to 155 francs, while C spends £3, 2s. on railway tickets. In the bill that B pays, a sum of 20 francs is to be divided between the accounts of A and C; but otherwise the expenses are to be shared equally. Show that A and C are both in B's debt, and find, in English money, to what extent. (Consider one pound sterling equal 25 francs.)

GLASGOW, May 1888.

1. What is meant by *Numeration*? What by *Notation*? Express in words the number 21068001.
2. A number is divided by 13; the quotient is 736, and the remainder 7. Find the number.
3. How many sixpences are in the sum of 20 guineas, 27 half-crowns, and 49 shillings?
4. Find by the Rule of Practice the value of 683 articles at £3, 6s. 3½d. each.
5. Define a fraction. Find the value of $\frac{1}{2} + 6\frac{1}{2} + 3\frac{3}{4} + 7\frac{1}{4} + \frac{1}{8}$.
6. Simplify $12\frac{1}{2}$ of $\frac{9\frac{1}{2} - 8\frac{1}{2}}{12\frac{1}{2} - 7\frac{1}{2}} \div \frac{1 + \frac{1}{2}}{7}$.
7. State the rules for the multiplication and division of decimals. Multiply and divide 4.14403 by 0.0101.
8. The rent of 6½ acres is £14, 4s. 4½d. What will be the rent of 28 ac. 1 ro. 25 po. of the same quality of land?
9. If 5 men or 7 women can do a piece of work in 6 hours, in what time will 3 men and 3 women do the work?

ABERDEEN, June 1888.

- Express in words 1008016, and in figures Twelve hundred thousand. Find the difference between the two numbers.
- What number multiplied by 43 will give the same result as 43,731 multiplied by 86,040?
- A young pupil, on being asked to multiply a number by 79, placed the line got on multiplying the number by 7 directly below that got on multiplying by 9, *without moving a figure to the left*, and then added.
What was the number *really* multiplied by?
If 14,016 was got as answer by the pupil, find the number that had to be multiplied.
- In a factory 40 men, 30 women, 20 boys are employed. They all work 9 hours a day for 5 days of the week, and 4 hours on Saturday. The wages are 5d., 3d., 2d. an hour for a man, a woman, and a boy respectively. Find the whole sum paid in wages every week.
For how many weeks will £875, 17s. 6d. suffice to pay the wages?
- If 1 cwt. 1 qr. 21 lb. of copper cost £4, 15s. 10d., what is the price per ton?
- Simplify the expression $\frac{11\frac{1}{2} - \frac{2}{3} \text{ of } 9\frac{1}{2}}{\frac{1}{2} \text{ of } 3\frac{1}{2} + \frac{1}{3}\frac{5}{8}}$.
- From a plank 38 feet long as many pieces as possible, each $3\frac{1}{2}$ feet, are to be cut. How many of these pieces will there be? And what is the length of the piece of plank that remains?
- Multiply .0064 by .0048. Divide 7.835 by (a) .00125, (b) 12500. Reduce to vulgar fractions in their lowest terms:
.3125, .056, 5.161881.

ST ANDREWS, June 1888. .

- Divide Two hundred and ninety million five hundred and two thousand and thirty-six by Three hundred and ninety-six.
- Add together

£341	15	2½
37	12	7½
491	5	3
63	9	4½
253	17	5
184	6	8½
312	18	6
376	14	9½
- Multiply £83, 17s. 10½d. by 347.
- Reduce 7,000,000 inches to miles.
- Reduce 2 tons 4 cwt. 6 lb. 5 oz. to ounces.

6. If a ship brings 300,000 ounces of gold, how much coal would weigh as much as the gold?
7. Simplify $(3\frac{1}{2} - \frac{2}{3} \text{ of } \frac{4}{15}) \div (21\frac{1}{2} + \frac{3}{10} + 4\frac{1}{2} \text{ of } 5)$.
8. By what fraction must $\frac{2}{3}$ of $(\frac{2}{3} + \frac{1}{15})$ be divided that the quotient may be 5?
9. Find, by Practice, the cost of 837 articles at £1, 18s. 3½d. each.

EDINBURGH, *June 1889.*

1. Multiply 23·0123 by 3·024; and divide ·00656136 by ·0312.
2. Simplify $\frac{19}{17} \text{ of } \frac{306}{361} + \frac{2}{57} \text{ of } \frac{6}{8} - \frac{4}{95} \text{ of } \frac{15}{48}$; and

$$\frac{2\cdot308 - 1\cdot095}{2\cdot427 + 2\cdot425} + \frac{3\cdot339 - 1\cdot108}{4\cdot467 + 4\cdot457}$$
3. Find the G.C.M. of 2873, 3211, and 3887; and the L.C.M. of 4183 and 4371.
4. Find the total cost of the following: 250 articles at 2s. 6d., 300 articles at 3s. 6d., 1000 articles at 2½d., and 125 articles at a guinea.
5. A man mixes 250 lb. of tea at 1s. 6d., 200 lb. at 2s., and 150 lb. at 2s. 6d., and sells the mixture at 2s. the pound. Find the total gain on the transaction, and also the gain per cent.
6. Find to the nearest penny the value of a plot of ground measuring 50 ft., by 60 ft., the value of an acre being £40.
7. If 20 marks are worth 19s. 8d., and an English sovereign is worth 18 Danish crowns; find the value of 1000 marks in Danish crowns.

GLASGOW, *June 1889.*

1. Explain the terms—minuend, product, quotient, even number, prime number.
2. Multiply Four hundred million two thousand and seven by fifty-seven thousand and ninety.
3. Divide Seventy-six thousand and fifty-three by seven, and divide the quotient so obtained by nine.
4. A farmer sells 29 sheep at £1, 3s. 6d. per head, and 17 sheep at £1, 11s. 3d. per head: how many can he buy with the proceeds at 19s. 3d. per head?
5. Simplify $\frac{2\frac{1}{2} - \frac{2}{3}}{2\frac{1}{2} + \frac{2}{3}} + \frac{7}{2} \text{ of } (\frac{9 \times 10}{14 \times 3} - \frac{22\frac{1}{2}}{30})$.
6. Find the product of 0·612 and 88·8 correct to three decimal places.

7. What is the value of 5 tons 3 qr. 21 lb. at £5, 4s. 8d. per cwt.?
8. How many acres of land may be rented for £153 at the rate of £18 for 6 ac. 3 ro. 36 poles?
9. What will be the expense of carpeting a room whose length is 22 ft. 8 in., and breadth 17 ft. 4 in., if the carpet cost 2s. 3d. a square yard?

II. MEDICAL PRELIMINARY EXAMINATIONS.

EDINBURGH, *March 1886.*

1. What is the price of gold per ounce when 803 lb. 7 oz. cost £37,547, 8s. 7½d.?
2. Reduce 308,471,296 square inches to acres, roods, poles, &c.
3. Find, by Practice, the cost of 8443 articles at £3, 17s. 10½d. each.
4. Find the square root of 14 to six decimal places.
5. Multiply .04093 by .00779; and divide .00607005 by .615.
6. Add together $5\frac{5}{16}$, $11\frac{1}{2}$, $16\frac{1}{4}$, and $\frac{1}{2}$; and multiply together $\frac{4}{5}$, $1\frac{1}{2}$, and $7\frac{1}{2}$.
7. At what rate per cent. per annum, simple interest, will £1427 amount to £1658, 17s. 9d. in 5 years?
8. If the wages of 29 men for 27 days amount to £120, 14s. 3d., how many men must work 8 days to receive £814?
9. Two trains start at the same time from two stations 60 miles apart, and travel towards one another, the one at 40 miles an hour and the other at 30. After what time will they meet, and how far has the faster train then gone?
10. A man has £10,000 in the 3 per cents. He sells out at 98, and invests £4000 in the 4 per cents. at 104, and the remainder in railway shares at 87½ paying a dividend of 5 per cent. Find his income from each stock.

GLASGOW, *March 1886.*

1. Multiply One million one hundred thousand seven hundred and eighty-five by Seventy-one thousand and fifty-three.
2. Divide Forty-six millions one hundred and twenty-one thousand three hundred and sixty-six by Seven thousand six hundred and sixty-nine.
3. How many tons are there in 32,391 oz. avoirdupois?

4. What is the value of 5 tons 2 qr. 21 lb. at £7, 9s. 4d. per cwt.?
5. Find the value of $\frac{2\frac{1}{2}}{3} + \frac{1\frac{1}{2}}{17}$ of $2\frac{3}{4}$ diminished by $\frac{2\frac{1}{2}}{2\frac{3}{4}} + \frac{1\frac{1}{2}}{17}$ of $28\frac{1}{2}$.
6. Divide $2\frac{4}{5}$ by the sum of $3\frac{1}{2}$ and $6\frac{8}{9}$.
7. Reduce 2s. 6d. to the decimal of 6s. 8d.
8. The length of a room is 21 ft., its breadth $15\frac{1}{2}$ ft., and its height 13 ft. Find the number of square yards in its floor and in its walls.
9. At what rate will the interest on £4127, 10s. amount to £92, 17s. 4½d. in a year?
10. A coach goes from London to Liverpool at the rate of 9 miles an hour in 24 hours. In what time would the distance be traversed by a train, moving at the rate of 32 miles per hour?

EDINBURGH, October 1886.

1. Find the cost of 2062 articles at £7, 2s. 11d. each.
2. Reduce 4322287 inches to miles, furlongs, &c.
3. Reduce to their simplest forms $\frac{99506173}{145432099}$ and $\frac{3\frac{3}{4} + 12\frac{1}{2}}{2\frac{1}{2} - 3\frac{1}{2} + 5\frac{3}{4}}$.
4. Multiply .014957 by .001579, and divide 31884.47 by .0779.
5. Find the square root of 365 to six places of decimals.
6. Reduce .1769626 and 1.126 to vulgar fractions in their lowest terms; divide the former by the latter, and express the result as a recurring decimal.
7. Find the cost of carpeting a room 26 ft. 3 in. by 21 ft. 4 in. with carpet 2 ft. 4 in. wide, at 1s. 4½d. a yard.
8. A merchant bought a number of eggs at 15 for a shilling, and as many more at 20 for a shilling, and retailed them at a penny each. How much did he gain per cent. on the whole transaction?
9. A, B, and C can mow a field in 6 days. B and C can do it in 9 days, and A and B in 10 days. How long would each take to do it, working separately?
10. What sum will amount to £7408, 16s. in three years at 5 per cent., compound interest?

EDINBURGH, March 1887.

1. Divide £11,594, 3s. 10½d. by 695.
2. Reduce 3467331 square feet to acres, roods, &c.
3. Reduce to their simplest forms $\frac{331375}{908875}$ and $\frac{1\frac{1}{2} + 2\frac{1}{2}}{12\frac{1}{2} + 1\frac{1}{2} - 11\frac{1}{2}}$.

4. Find, by Practice, the cost of 14,375 articles at £3, 17s. 11d. each.
5. Express the sum of 3.465 tons, 5.432 cwt., 3.476 qr., and 6.73 lb. as a decimal of a ton.
6. Find the square root of 17 to six places of decimals.
7. Find the cost of painting the outside of a rectangular box 6 ft. 8 in. long, 2 ft. 8 in. wide, and 2 ft. 6 in. high, at $\frac{1}{4}$ d. per square foot.
8. A commenced business with a capital of £1000; at the end of two months B joined him with £1200, at the end of six months C joined with £1500, and at the end of eight months D joined with £2000. How ought a profit of £2050 to be divided at the end of the year?
9. A person has £12,000 stock in the 3 per cents. He sells out at 92, and invests in 4 per cent. debentures, thereby increasing his income by £8. How much does he pay for the debentures?
10. A man bought 3 boxes of oranges, each containing the same number. They cost respectively 1d. for 3, $1\frac{1}{4}$ d. for 4, and $2\frac{1}{4}$ d. for 6. How much per cent. would he gain by retailing the whole at $\frac{1}{4}$ d. each?

GLASGOW, *March* 1887.

1. From the sum of Thirty-two million five hundred and seven thousand eight hundred and two, and Forty-nine million three hundred and seventy-six, subtract Sixty-three million sixty-three thousand and sixty-three.
2. Find the quotient and remainder when 578361 is divided by 472.
3. Find the difference between the greatest and least of the fractions $\frac{1}{4}$, $\frac{2}{5}$, $\frac{3}{7}$, $\frac{4}{9}$.
4. Express in its simplest form $\frac{306 \times 234 \times 5605}{221 \times 324 \times 1121}$.
5. What is the value of 15 tons 6 cwt. 2 qr. at £4, 11s. 8d. per cwt.?
6. Multiply together 5.016, .0021, and 3.013.
7. Divide .2134 by .367.
8. A coach which travels at the rate of 8 miles per hour, takes 12 hours to go from A to B. In what time would a train, which travels at the rate of 28 miles per hour, do the journey?
9. At what rate will the interest on £4127, 10s. amount to £92, 17s. $4\frac{1}{4}$ d. in a year?
10. If the income-tax on £200 be £2, 7s. 9d., what is it on £350?

EDINBURGH, *October 1887.*

1. The following quantities of wheat were imported into London during the week ended 9th September 1887 :

From Canada	25,204	qr.
" Russia	19,873	
" United States	16,439	
" India	8,567	
" Argentine Confederation	4,054	
" Germany	1,681	
" Continent	197	

Find the total quantity imported, and the percentage of that total obtained from Canada.

2. Find the L.C.M. of 121, 132, 143, 154, and 165.

$$\text{Simplify } \frac{2176701}{5145951}.$$

3. Find the total value of 315 things at £2, 3s. 9d. each, 216 things at 11s. 2d. each, and 602 things at 3½d. each.
4. As an exercise in contracted multiplication, find the value of $3.14159 \times .23456$, correct to three places of decimals.
5. Simplify $(3\frac{1}{2} \text{ of } 5\frac{1}{2}) + \{ \frac{1}{2} \text{ of } (6\frac{1}{2} - 1\frac{1}{2}) \} - \frac{2\frac{1}{2}}{2}$.
6. What vulgar fractions can be expressed *accurately* as decimals ? Reduce $\frac{1}{2} + \frac{1}{4} + \frac{1}{8}$ to a single decimal.
7. Find the simple interest on £847, 3s. 7d. for 5 years at 5 per cent. per annum.
8. Find the retail price of a book, when the cost price is 15s. 9d., 5 per cent. is allowed for expenses, and a profit of 22 per cent. is made.
9. Extract the square root of 1369.7401.
10. A person has a certain distance to walk. If he walks at the rate of $\frac{1}{4}$ miles an hour, he will arrive 5 minutes late, and if he walks at the rate of 5 miles an hour, he will arrive 10 minutes too soon. What is the distance he has to travel ?

EDINBURGH, *March 1888.*

1. Add
- | | | |
|--------|----|----|
| £5,632 | 4 | 2 |
| 4,187 | 16 | 6½ |
| 437 | 15 | 7½ |
| 596 | 13 | 1½ |
| 8,701 | 9 | 5 |
| 4,728 | 6 | 11 |
| 1,408 | 13 | 6½ |
| 19,403 | 13 | 8 |
| 27,391 | 4 | 6½ |
| 14,762 | 3 | 4 |

2. Find the G.C.M. of 4212, 2358, and 6138.
3. If by selling an article at 12s. I lose 25 per cent., at what must I sell it to gain 25 per cent.
4. Prove that $\frac{2}{3} = \frac{1}{\frac{3}{2}}$.

$$\text{Simplify } \frac{2 + 5\frac{1}{2} - 3\frac{3}{4}}{3 + 1\frac{1}{2} - 2\frac{3}{8}}.$$

5. Find the square of 2.307 and the cube of .234.
6. If the income-tax were $2\frac{1}{2}$ per cent. instead of 5d. in the £, what difference would it make to a man whose gross annual income is £764, 2s. 6d.?
7. Reduce 5s. to the decimal of 3s. 4d., and 3s. 4d. to the decimal of 5s.
8. Reduce each of the following to single decimals :
 (1) $.00125 \times 4.0135 \times .001 \times .000025$.
 (2) $.1 \div .5$. (3) $.1 \div .0005$. (4) $.1 \div 5000$.
9. At what rate will the simple interest on £326 for 15 years amount to £220, 1s.?
10. Express $\frac{1}{6^0} + \frac{1}{6^2} + \frac{1}{6^3} + \frac{1}{6^4} + \frac{1}{6^5}$ as a single decimal correct to five places.

GLASGOW, *March* 1888.

1. From the sum of Thirty-four millions five hundred and sixteen thousand four hundred and thirty-seven, and Twenty-three millions six hundred and twenty-seven thousand three hundred and forty-nine, subtract their difference.
2. Multiply 32457 by itself, and from the result subtract 32456×32456 .
3. Arrange in descending order of magnitude $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$, $\frac{1}{4}$.
4. Divide .34864 by .0213, the answer to be correct to five places of decimals.
5. A man has £10,450 invested at 3 per cent. per annum. How much is his yearly income diminished when the rate is lowered to $2\frac{1}{2}$?
6. If twenty men working 8 hours a day perform a certain piece of work in 18 days, how many men would it take to do the same work in 9 days, working 10 hours a day?
7. Find the cost of 20 tons 14 cwt. 2 qr. at £12, 5s. per ton.
8. A train goes at the rate of 45 miles an hour. How many feet does it go in a second?
9. Find the area of a room whose length is 20 ft. 10 in. and breadth 14 ft. 5 in.
10. Divide a sum of £3 into an equal number of half-crowns, florins, shillings, and sixpences.

EDINBURGH, *October 1888.*

- Find the price of 7 cwt. 3 qr. 11 lb. at £2, 13s. 1d. per quarter.
- Find the L.C.M. of 5, 6, 9, 15, 24, 27, 126.
- Simplify $\frac{\frac{1}{2} + \frac{1}{3} + \frac{1}{4}}{1\frac{1}{2} + \frac{1}{3} + \frac{1}{4}}$.
- Divide the product of .00145 and 15.625 successively by 6.25, .625, and .0625.
- Reduce $1\frac{1}{2}$ to a decimal fraction correct to four decimal places, and express .32401 as a vulgar fraction.
- A square whose side is 146 feet contains 1980.25 square metres. Find the number of inches in a metre correct to three decimal places.
- If by selling at 11s. 6d. a yard a man loses 15 per cent. on his outlay, what will he gain or lose by selling at 13s. 6d. a yard?
- In how many years will a sum of money double itself at 4 per cent., simple interest? If a sum double itself in 15 years, what is the rate per cent.?
- Define *Discount*. Find the discount on £1294, 10s. for $1\frac{1}{2}$ years, and the interest on the discount for the same time, at $4\frac{1}{2}$ per cent.
- A and B work together for 4 days at a piece of work which they could complete in 12 days. B leaves, and A finishes the remaining work in 20 days. How long would it have taken B to do it alone?

EDUCATIONAL INSTITUTE OF SCOTLAND, *October 1888.*

- Express in words the following numbers, and find their *sum*: 20,405, 705,800, 3,000,020, 5,701,900, 300,003,003.
- Find the *product* and *quotient* of 867,490 and 80,900.
- How many sovereigns are there in 160 half-guineas, and how many half-crowns in 2000 florins?
- Find the cost of 30 dozen of wine at 4s. 11 $\frac{1}{2}$ d. a bottle; and if half-a-dozen bottles be spoiled, what will be gained by selling the remainder at 5s. 8 $\frac{1}{2}$ d. a bottle?
- Make out a bill for 1000 envelopes at 5d. for 50; 3 reams of foolscap at 1s. 1d. per quire (1 ream = 20 quires); 6 gross of pens at $\frac{1}{2}$ d. per dozen; 1000 pencils at 8 for a penny; 16 dozen rulers at 10s. per gross (1 gross = 144).
- Simplify $\frac{.002 \times 1.75 \div .00007}{1\frac{1}{2} \div \frac{1}{3}}$.
- Reduce $\frac{10 - \frac{4}{4\frac{1}{2}} + .5 + .4}{2}$ to a decimal.

8. If a street $1\frac{1}{2}$ miles long be repaired at a cost of £150, what part of the expense should be paid by an inhabitant whose premises have a frontage of 22 yards $1\frac{1}{2}$ feet?
9. Two couriers pass through a town at an interval of 4 hours, travelling at the rate of $11\frac{1}{2}$ and $17\frac{1}{2}$ miles an hour. How far and how long must the first travel before he is overtaken by the second?
10. A can mow an acre of grass in $\frac{2}{3}$ of a day, and B in $\frac{3}{4}$ of a day; in what time could A and B do it working together?

III. LEAVING CERTIFICATE EXAMINATIONS.

June 1888.

HIGHER GRADE AND HONOURS.

1. Explain the principle of the process for converting a vulgar into a decimal fraction, and indicate the conditions that the decimal terminate.

Express

$$\frac{(\frac{2}{3} + \frac{1}{6} - \frac{1}{2})(\frac{2}{3} + \frac{1}{6} + \frac{1}{2}) + (1 - \frac{2}{3} - \frac{1}{6})(1 + \frac{2}{3} + \frac{1}{6})}{\frac{7}{12}(\frac{1}{2} + \frac{2}{3})}$$

as a decimal (to 4 places).

2. Express in English money to the nearest penny the amount of the following bill in French money: 3.35 articles at 6.37 fr.; 23.63 articles at 1.34 fr.; 15.37 articles at 7.15 fr.; allowing 25.42 fr. for £1.
3. A certain sum of money put out at $4\frac{1}{2}$ per cent. simple interest, for 10 years, amounted to £1356 after income-tax was deducted from the interest at the rate of 5d. in the pound. What was the sum?
4. I bought 25 shares of a certain company at £135 each, the paid-up capital for each share being £100. During the year I got a dividend of $5\frac{1}{2}$ per cent. on the paid-up capital, and a bonus of £35 on my 25 shares. What rate of interest did my investment bring me?
5. For how much should a house worth £5122 be insured at $2\frac{1}{2}$ per cent., so that in case of loss the value of the house and the insurance premium may be repaid?
6. What is the difference between simple interest and true discount on a bill for £400 due in 9 months, when interest is at 4 per cent. per annum?
7. A locomotive engine making 162 strokes per minute, travels 90 miles in two hours. How many strokes per minute must the same engine make to do 200 miles in $4\frac{1}{2}$ hours?
8. From 9.6 of a £ take 5.037 of a guinea, and express the result in decimals of a shilling.

OPTIONAL QUESTIONS.

(In these questions the candidate may use logarithms.)

9. The population of a country was 4,314,000 to begin with, and increased by 3.168 per cent. every year for 5 years. What was the population at the end of the 5 years?
10. A square pond is surrounded by a strip of lawn whose breadth is the same on all the four sides. If the side of the pond be 32 yd. 2 ft., and the breadth of the lawn 25 yd. 1 ft., find the area of the lawn.
11. An estate, which consists of a circular piece of ground $1\frac{1}{2}$ miles in diameter, is left to 5 sons, 4 of whom get each what is equivalent to a circle 400 yards in diameter, while the fifth gets the remainder. If the area of a circle is $\frac{11}{16}$ of the square on the diameter, what percentage of the estate goes to each son?
12. A person walks from Rugby to London in 4 days, and back in 5 days. Each day he walks one mile less than on the preceding day. What is the distance between the two places?

LOWER GRADE.

1. Explain the rule for the addition of vulgar fractions.

$$\text{Simplify } \frac{6756}{6193} - \frac{4114}{4488}$$

2. Find the total of the following bill :

35 articles at	£1	6	3
15½ "	0	11	3½
6½ "	0	17	6
4½ "	3	15	7½

3. Express as a single decimal :

$$.0164 \times 2.013 + .0168 \div .0084 - 1.305 \times 2.006.$$

4. Calculate the simple interest on £3468, 4s. 6d. for 4.25 years at 3.168 per cent.
5. A grocer sells his best quality of tea at 3s. 6d. per lb., and thereby gains a profit of $\frac{1}{4}$ per cent. ; he sells his second quality at 2s. 6d. per lb., gaining a profit of 6 per cent. At what price must he sell a mixture composed of two parts of the second quality to one of the first, so as to gain a profit of 5 per cent?
6. A wall is covered with plaster $1\frac{1}{2}$ inches thick. How many square yards will be covered by a cubic yard of plaster?
7. Which is the greatest of the three sums, $\frac{1}{17}$ of £1, $\frac{1}{17}$ of a guinea, $\frac{1}{17}$ of half-a-crown?

8. Express (1) 17294544 square inches in acres ;
 (2) $2\frac{1}{2}$ lb. troy in lb. oz. drs. avoirdupois, 7000 grains going to an avoirdupois lb., and 5760 grains to a troy lb.
9. One man can do a piece of work in 12 hours, another in 16, another in 48. How long would all three working together take to finish it?
10. If £1095 lying at interest for 117 days becomes £1118, 8s., what is the rate of interest per cent. per annum?
11. A person owning £1000 3 per cent. stock, has to sell out as much as will pay a debt of £105, 15s. If the 3 per cents. are at 94, how much stock has he to sell out?
12. Simplify $\frac{2.03 + 1.21}{2.03 - 1.21}$, giving the answer in decimals.

Reduce every term in this to a fraction, and compare the results.

June 1889.

HIGHER GRADE AND HONOURS.

1. Which is the greatest, and which the least of the following expressions : $1 - \frac{1}{7}$, $\frac{1}{2 + \frac{1}{1 + \frac{1}{8\frac{1}{2}}}}$, $3\frac{1}{4}$?
2. A square field contains an acre. Find the length of one side in yards to three places of decimals.
3. Simplify the expressions
 (1) $\frac{.016}{.423 - .423}$ of $\left(\frac{385}{407} - \frac{14}{15}\right)$;
 (2) $.8\frac{1}{2}$ of a shilling \div $.03$ of 2s. 6d. \div $.05416$ of £1.
4. A hundred pfennige = one mark; and £1 is worth 20 marks 35 pfennige. Calculate, in marks and pfennige, the value of a bill of exchange for £476, 15s.
5. Show that, in finding the G.C.M. of two numbers by the method of division, it is permissible to reject from each remainder, before using it as a divisor, any factors which do not divide the preceding divisor. Find by this method, or otherwise, the G.C.M. of 976,239 and 742,343.
6. Four months before the half-yearly dividend is payable, an investor buys stock in the $2\frac{1}{2}$ per cents. at $93\frac{1}{4}$, paying also $\frac{1}{4}$ th per cent. for brokerage. Immediately after the dividend is paid, he sells out at $93\frac{1}{4}$ (no charge for brokerage). Find the rate of interest per cent. per annum which he obtains on the transaction.

7. Assuming that the ratio of the diameter of a circle to the circumference is 113 to 355, and that the diameter of the earth is 7912 miles, and that 10,000,000 mètres are equal to one-fourth of the earth's circumference, find the value of a mètre in inches to two places of decimals.
8. Find by Horner's method, or otherwise, the cube root of 10 to four places of decimals.
9. State and prove the rule for finding whether a number is divisible by 9, without actual division. If the basis of our system of notation were 7 instead of 10, what would be the tests of divisibility by 2, 3, and 4?

SECOND OR LOWER GRADE.

1. Reduce 100,000 square feet to acres, roods, &c., giving the result in a form free from fractions.
2. Find the cost of 126,516 articles at £2, 3s. 6d. per dozen.
3. Explain the terms Greatest Common Measure and Least Common Multiple of two numbers. Find the G.C.M. and the L.C.M. of 195, 546, and 286.
4. Simplify the expressions
 - (1) $\frac{(2\frac{1}{2} + \frac{1}{2}\frac{1}{2}) \div (7\frac{1}{2} - 1\frac{1}{2})}{(\frac{1}{2} - \frac{1}{4}) \times (\frac{1}{2} - 1\frac{1}{2})}$
 - (2)
$$\frac{3}{4 + \frac{3}{4 + \frac{1}{2}}}$$
 - (3) .175 of a ton + .195 of a cwt. + .145 of a quarter, giving the result in pounds and decimals of a pound.
5. Express as a single decimal $(47 + .047) \times (47 - .047) \div .0047$.
6. Find the simple interest on £5006, 13s. 4d. for $2\frac{1}{2}$ years at $3\frac{1}{4}$ per cent.
7. Find the value of a property when a person who possesses $\frac{3}{4}$ of it sells $\frac{1}{4}$ of his share for £620, 8s.
8. When the number 2566524 is divided by a certain divisor, the quotient is 875, and the remainder 149; find the divisor.
9. A person, having £5, pays away .05 of his money, and then .15 of the remainder; express the money he now has as a decimal of £10.
10. A tradesman by selling an article for 6s. 9d. gains 35 per cent. What would he have gained per cent. if he had sold it for 8s. 3d.?
11. Find the square root of 46,362,481.
12. A piece of work can be done in 48 days by 15 men, but after 9 days' work two of the men leave off working. How many additional days will the men who remain require to finish the work?

TEST EXERCISES.

Note.—Candidates preparing for the Local Preliminary Arithmetic should work the first 7 or 8 questions; candidates for the Medical Preliminary Arithmetic and Leaving Certificate should work all the questions.

I.

1. A railway viaduct contains 37 arches, and in the construction of each arch 16048 bricks are required; find the total number of bricks and their cost at a halfpenny each.
2. Reduce 1 ton 12 lb. 8 oz. to drams, and prove the result.
3. Find the sum of $\frac{1}{2} + \frac{2}{3} + \frac{3}{4} - \frac{1}{11} - \frac{1}{13} - \frac{1}{15}$.
4. Find the value of $\cdot 5\bar{3}$ of 7s. 6d. + $\cdot 71428\bar{5}$ of 17s. 6d. - 3.75 of 1s. 8d.
5. If a man take 108 steps of $2\frac{1}{2}$ ft. each in a minute, how long will he take to walk 10 miles?
6. A garden-plot measures $27\frac{1}{2}$ yd. by 24 yd.; express its area as a decimal fraction of an acre.
7. A grocer bought 15 cwt. of sugar at 18s. 8d. per cwt. and retailed it at $2\frac{1}{2}$ d. per lb. Find his whole gain and his gain per cent.
8. A owns $\frac{2}{3}$ of a vessel, B $\frac{1}{3}$ of it, and C the remainder. C sells his share for £16,500. Find the value of the vessel; also the value of A's share and of B's share.
9. A boy takes $6\frac{1}{2}$ minutes to walk round a rectangular field 192 yd. by 108 yd. How long will he take to walk round a square field of the same area?
10. £1000 is deposited at compound interest for 2 years at 5 per cent.; its amount is then invested in 3 per cent. stock at 98; what half-yearly dividend will it yield?

II.

1. Multiply the sum of Nineteen thousand and nineteen, and seven thousand and twenty-eight by Three hundred and forty-five. Write the product in words.
2. A farmer's wife supplies a grocer with 35 lb. of butter at 1s. 3d. per lb., and 19 doz. of eggs at 1s. 1d. per doz. She receives as part payment, 4 lb. tea at 2s. 8d. per lb., and 56 lb. sugar at $2\frac{1}{2}$ d. per lb. How much money should she receive?
3. Simplify (a) $\frac{1\frac{1}{2} - \frac{7}{8}}{1\frac{1}{2} + \frac{7}{8}}$; (b) $\frac{\frac{1}{2} \text{ of } 3\frac{1}{2} + 2\frac{1}{2}}{\frac{1}{2} \div 1\frac{1}{2}}$.
4. Express as a single decimal $\frac{2.514 - 1.403}{1.1} + \frac{.02415}{10.5} - \frac{.18}{150}$.
5. The rental of a burgh is £18,200, and a school-rate of £341, 5s. is required. What rate per £ must be levied?

6. Find the cost of paving a rectangular court-yard $40\frac{1}{2}$ yd. long and 64 ft. 6 in. wide, at 1s. 8d. per sq. yd.
7. Divide £7, 10s. between a man, a woman, and a boy, so that the man may get half as much again as the woman, and the woman as much again as the boy.
8. A grain-merchant sold $37\frac{1}{2}$ qr. of wheat for £112, 10s., being a gain of 20 per cent. on the cost price. Find the cost price of a quarter.
9. Find the difference between the simple and the compound interest on £6250 for 3 years at 4 per cent.
10. Edinburgh and North Berwick are 21 miles apart. A starts from E. at 9.30 A.M. and walks towards N. B. at the rate of 3 miles an hour. At 10.40 A.M. B starts from N. B. and walks towards E. at the rate of 4 miles an hour. When will they meet, and how far from Edinburgh?

III.

1. Divide Five hundred and eighteen millions three hundred and sixteen thousand three hundred and fifty by Five thousand and thirty. Write down the quotient in words.
2. Multiply £17, 15s. 11½d. by 180, and reduce the product to half-crowns.
3. Divide equally among 28 poor people, 12 cartloads of coal each weighing 19 cwt. 3 qr., and 8 cartloads each weighing 1 ton 3 cwt. 21 lb.
4. Add together $\frac{2}{3}$ of a guinea, $\frac{3}{4}$ of £1, 4½s., and reduce their sum to a fraction of £3, 3s. 9d.
5. Express as decimal fractions, and add together :
 $\frac{7}{10}$, $\frac{1}{100}$, $15\frac{11}{100}$, $\frac{11}{1000}$, and $36\frac{11}{1000}$.
6. A land-measurer's chain contains 100 links, and measures 22 yd. long; find the length of a link in inches and decimals of an inch.
7. How long will it take to accomplish a journey of 168 miles; 28 miles by road at the rate of 6 miles an hour, 110 miles by rail at the rate of 30 miles an hour, and the remainder by steamer at the rate of $12\frac{1}{2}$ miles an hour?
8. By selling an article at 13s. 9d., 10 per cent. is gained; find (1) the cost price, (2) the selling price, so as to gain 25 per cent.
9. If I pay 15s. 9d. for 90 apples when 20 apples weigh 7 lb., how many of the same quality should I get for £1 when 12 apples weigh 5 lb.?
10. A certain sum invested in $3\frac{1}{2}$ per cents. at 98, yields £5 more of annual income than the same sum invested in 3 per cents. at 90. Find the sum invested and the income in each case.

IV.

1. Multiply the sum of Three hundred thousand, three hundred and seventeen thousand and eighty-nine by Sixty-two thousand five hundred.
2. Express in farthings the sum of 27 guineas, 55 crowns, 89 half-crowns, 111 florins, 357 sixpences.
3. How many plots of ground $15\frac{1}{2}$ yd. long, and $13\frac{1}{2}$ yd. wide, can be feued from an acre?
4. Find the G.C.M. of 286 and 1703. Find also the largest sum of money contained an exact number of times in £3, 2s. 6d. and £26, 0s. 10d.
5. Add together $3\frac{1}{2}$, $\frac{2}{3}$ of $1\frac{1}{2}$, $1\frac{1}{2}$ of $3\frac{1}{2}$, and $\frac{1}{2}$, and subtract the sum from 20.
6. Simplify $\frac{356 \cdot 125 \times \cdot 0123}{1 \cdot 353}$.
7. If $4\frac{1}{2}$ yd. cost 15s. 9d., find the price of 9 pieces of cloth each measuring $27\frac{1}{2}$ yd.
8. What sum of money will amount to £1275, 10s. 5d. in 7 months at $3\frac{1}{2}$ per cent.?
9. A sum of money is divided between A, B, C, and D, in the proportion of 3, 5, 7, 10; C and D together get £425. Find the whole sum, and the share of each.
10. Find the cost of carpeting a room 24 ft. 9 in. by 17 ft. 6 in. with carpet $\frac{1}{2}$ yd. wide, at 4s. 6d. a yard.

V.

1. Simplify $39(7644 + 3456) \div 13(50 - 13)$.
2. A bushel of barley weighs 54 lb. Find in cwt., qr., lb., the weight of 39 bushels.
3. Find the value of 2 tons 11 cwt. 3 qr. at £4, 16s. 8d. per cwt.
4. Simplify $7\frac{1}{2} + 1\frac{1}{2} - \frac{1}{2} + 5\frac{1}{2} - 3\frac{1}{2}$.
5. Find the value of 2.25 of 5s. + .016 of £1, 10s. + .016 of 9s. 3d. - .857142 of 10s. 6d.
6. If a person's rent be £48 a year, how much will he pay annually for local rates when the police-rate is 2s. 7d., poor-rate 9d., school-rate 4d., and water-rate 7d. in the £?
7. If a sum of money gain £37, 10s. in 4 years at $3\frac{1}{2}$ per cent., how much would the same sum gain in 7 years at $3\frac{1}{2}$ per cent.?
8. A leaves Glasgow for Stirling, walking $3\frac{1}{2}$ miles an hour; at the same time B leaves Stirling for Glasgow, walking $3\frac{1}{2}$ miles an hour; when will they meet, and how far from Glasgow, the whole distance being 29 miles.
9. What principal will gain £171, 3s. in two years at $3\frac{1}{2}$ per cent., compound interest?

10. A house consists of 5 storeys and is let to 5 tenants; the rent of each storey is $\frac{1}{5}$ of the rent of the storey below it; the rent of the middle storey is £33, 15s. Find the other rents.

VI.

1. A mile contains 1760 yd.; a postman walks on an average 23 miles a day. How many yards will he walk in a year (313 days)?
2. Subtract 34,567 farthings from £100, and multiply the remainder by 89.
3. Simplify $\frac{\frac{1}{2} - \frac{1}{3}}{\frac{1}{3} - \frac{1}{4}} + \frac{\frac{1}{4} - \frac{1}{5}}{\frac{1}{5} - \frac{1}{6}} + \frac{\frac{1}{6} - \frac{1}{7}}{\frac{1}{7} - \frac{1}{8}}$.
4. Add together 11.125, .01875, 105.25, .875, .78125, 3.65, and divide their sum by .0005.
5. A bankrupt owes £2880, and his assets are worth £1272. What dividend can he pay, and how much will a creditor lose to whom he owes £750.
6. Sugar costs 16.5s. per cwt., and is sold at .2083s. per lb. Find the profit on a ton.
7. After cutting off $\frac{1}{3}$ from a web of cloth and then $\frac{1}{4}$ of the remainder, there remain 17 $\frac{1}{2}$ yd. Find the length of the web.
8. In 1871 the population of a town was 17125; in the next ten years it increased 16 per cent. What was its population in 1881?
9. Find the square root of .0009641025; 185 $\frac{1}{4}$.
10. A person having received present payment of a bill of £495, 12s. 6d., due 4 months hence at 5 per cent., invests the money in three per cent. stock at 97 $\frac{1}{2}$. Find his half-yearly income from it.

VII.

1. Add together Three thousand and three, seven hundred and seventy, ten thousand and ten, seven thousand eight hundred and ninety-two, and twelve; subtract the sum from One hundred thousand, and multiply the difference by Four thousand five hundred.
2. Find by any method the value of 117 $\frac{1}{2}$ articles at £2, 8s. 8d. each.
3. From 52 weeks 1 day subtract 40 weeks 1 day 11 hours 24 min., and divide the remainder by 27.
4. How much greater is $\frac{2}{3}$ of $\frac{1}{5}$ of 5 guineas than $\frac{1}{4}$ of $\frac{1}{2}$ of 5 crowns?
5. Reduce to a single decimal

$$\begin{array}{r} 4.8 \times .423571 \\ \hline 2.8 \times .75 \end{array}$$

6. After paying income-tax at 4d. in the £, a man has a net income of £516, 5s. Find his gross annual income.

7. If the sixpenny loaf weigh 3 lb. 4 oz., when wheat is 72s. a quarter, what should the 4d. loaf weigh when wheat is 64s.?
8. A grocer mixes together 24 lb. of tea at 1s. 8d., 12 lb. at 2s., and 16 lb. at 2s. 6d. Find the average price of the mixture, and the gain per cent. by selling it as half-crown tea.
9. The difference between the true discount and the banker's discount on a sum of money due 5 months hence at 3 per cent. is 5s. Find the sum of money.
10. A block of granite is in the form of a cube, and each surface measures 12 sq. ft. 36 sq. in. Find (1) the length of its side, (2) its total surface, (3) its solid content.

VIII.

1. An estate consists of 27,380 ac., one-fourth of it is worth £125 an acre, and the remainder is worth £48 an acre; find the value of the whole estate.
2. A bicycle wheel is 55 inches in circumference; how often will it turn round in a run of $32\frac{1}{2}$ miles?
3. Reduce $\frac{3}{4}$, $\frac{1}{2}$, and $\frac{1}{3}$ to their lowest terms, and arrange the resulting fractions in order of magnitude.
4. What fraction of $\frac{2}{3}$ of $\frac{3}{4}$ of $2\frac{1}{2}$ guineas is $\frac{1}{4}$ of $1\frac{1}{2}$ of 5s. 3d.?
5. Express (1) .69375 of an acre in roods, poles;
(2) .7275 of a lb. troy in oz., dwt., and gr.
6. From a roll of cloth measuring $62\frac{1}{2}$ yd., $13\frac{3}{4}$ yd. are sold for £3, 1s. 10½d.; what should be paid for the remainder at the same rate per yard?
7. Find the simple interest on £337.5 for 2.5 years at 3.75 per cent.
8. A man wished to give 15s. each to a certain number of poor people, but found he had 10s. too little; he gave them 14s. 6d. each, and had 2s. over. Find the number of poor people, and the sum of money he had.
9. A can do $\frac{1}{4}$ of a piece of work in 5 min., B $\frac{1}{5}$ of it in $4\frac{1}{2}$ min., and C $\frac{1}{6}$ of it in 8 min. If A works alone for 15 min., how many minutes will B and C together take to do the remainder?
10. In what proportions must a grocer mix teas at 2s. 6d., 3s., and 3s. 6d. respectively, so that by selling the mixture at 3s. 4d. per lb. he may gain 14½ per cent.?

IX.

1. Find the total cost of the following:
480 articles at 1s. 10½d. each; 250 articles at 15s. a score;
150 articles at 8d. a dozen; and 750 articles at 3 a penny.
2. Simplify the following fractions:
(a) $1 - \frac{1}{2}$ of $(\frac{1}{3} + \frac{1}{4}) \times (\frac{1}{2} - \frac{1}{3})$,
(b) $1 - \frac{1}{3}$ of $\frac{1}{2} + \frac{1}{4} \times (\frac{1}{2} - \frac{1}{3})$.
3. Divide $(5.46)^2$ by $(.0013)^2$.

4. Find the cost of papering a room 22 ft. long, 18 ft. wide, and 9 ft. high, with paper 2 ft. wide at $2\frac{1}{4}$ d. per yard.
5. The map of a country is laid down to the scale of 10 miles (of length) to the inch. What area on the map will represent a district measuring 2880 acres?
6. If 5 men can hoe 9 ac. of turnips in 7 days of 10 hours, and 3 boys can do as much as 2 men, how many days of 8 hours will it take 14 boys to hoe 24 acres?
7. What sum of money lent at $5\frac{1}{2}$ per cent. simple interest will amount in 4 years to half a sovereign?
8. A gallon of water weighs 10 lb., and a litre of water one kilogramme. If one litre = 1.76 pints, express a pound as the decimal of a kilogramme.
9. If the manufacturer makes a profit of 10 per cent, the wholesale dealer one of 15 per cent., and the retail dealer one of 20 per cent., what is the cost to the manufacturer of an article for which the consumer pays £6, 6s. 6d.?
10. A man has invested £9880 in 3 per cents. at 104, and an equal sum in $2\frac{1}{2}$ per cents. at 95. He re-invests all his money in a new $2\frac{1}{2}$ per cent. stock. What must the price of this stock be if his income is not affected by the change?

X.

1. Find the difference between $\frac{1991}{1111}$ and $\frac{9999}{1111}$.
2. Reduce to a single fraction :
 (a) $\frac{.03 - .02997 + .00003}{.00539 + .00048 - .00491}$; (b) $\frac{.013 \times .015}{.78 \times .00004}$
3. How often could 121.36 be subtracted from 4247.6008? And what would be the remainder after the last subtraction?
4. The postage from Britain to France is $2\frac{1}{4}$ d., and from France to Britain 25 centimes. Find which is the cheaper, and what the difference is on 1000 letters. (£1 = 25 francs; 1 franc = 100 centimes.)
5. £325 deposited on 10th January 1889 amounts to £329, 11s. on 5th June. Find the rate per cent. per annum.
6. Extract the square root of 3.3 and of .3 each to four places of decimals.
7. Seven men can mow a field 880 yards by 660 yards in 8 days; what will be the length of the side of a square field which 8 men can mow in 21 days?
8. After deducting $8\frac{1}{2}$ per cent. from a certain sum, and then $6\frac{1}{2}$ per cent. from the remainder, there is £310, 5s. left. Find the original sum.

9. A ton of a certain kind of stone measures 15 cubic feet. What is the weight of a cubic metre in kilogrammes? (A metre = $39\frac{1}{8}$ in.; a kilogramme = $2\frac{1}{4}$ lb.).
10. An express train travels 100 miles in 2 hours 45 minutes, the speed of the train in the second half of the journey being $\frac{5}{8}$ of the speed in the first half. Find the speed in miles per hour in the second half of the journey.

THE END.

ARITHMETIC
FOR
UNIVERSITY EXAMINATIONS

ANSWERS

New Edition



W. & R. CHAMBERS
EDINBURGH AND LONDON
1890

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ARITHMETIC

FOR

UNIVERSITY EXAMINATIONS.

ANSWERS.

EXERCISE I.—NOTATION, NUMERATION, AND SIMPLE RULES.

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <p>(1) Six hundred millions four hundred and seven thousand and thirty-two.</p> | <p>(6) 12111.</p> |
| <p>(2) One thousand three hundred and seventy-six millions four hundred and twenty-eight thousand five hundred and seventy-two; Six hundred and thirty millions forty thousand two hundred and twelve; Thirteen millions one hundred and eight.</p> | <p>(7) 738534651;
Seven hundred and thirty-eight millions five hundred and thirty-four thousand six hundred and fifty-one.</p> |
| <p>(3) 907080701;
Eight millions seventy thousand six hundred and three.</p> | <p>(8) 77056.</p> |
| <p>(4) 5030052.</p> | <p>(9) 48745.</p> |
| <p>(5) 1312096042;
Ninety-six millions four hundred and fifty-two thousand three hundred and eighty-six.</p> | <p>(10) 177875.</p> |
| | <p>(11) Three hundred and ninety-four thousand nine hundred and seventy-nine.</p> |
| | <p>(12) 1071357.</p> |
| | <p>(13) 22 years.</p> |
| | <p>(14) 23 years.</p> |
| | <p>(15) 566.</p> |
| | <p>(16) 335129720.</p> |
| | <p>(17) 100111020210201.</p> |
| | <p>(18) 2413037732.</p> |

- (19) 1969759143 ;
One thousand nine hundred
and sixty-nine millions
seven hundred and fifty-
nine thousand one hun-
dred and forty-three.
- (20) 5606827304661.
- (21) Product = 23362176 ;
Diff. = 0.
- (22) 1904098.
- (23) 194461765261.
- (24) One hundred and twelve
thousand eight hundred
millions two hundred and
twenty-three thousand
nine hundred and twenty-
two ; Thirty thousand
and forty-seven ;
3754126.
- (25) Thirteen thousand eight
hundred and eighty-seven.
Remainder = 6609.
- (26) 5867.
- (27) 2256007.
- (28) 609.
- (29) 554407.
- (30) 9396⁵²²²₈₈₈₈.
- (31) 100020030.
- (32) 1127¹¹₁₁.
- (33) 291¹¹¹¹¹¹₁₁₁₁₁₁.
- (34) 952110¹₁.
- (35) 32600640.
- (36) 407508.
- (37) 67891.
- (38) 85763.
- (39) 119267¹¹¹¹¹¹₁₁₁₁₁₁.
- (40) 3652¹¹¹¹₁₁₁₁.
- (41) 50050¹¹¹¹₁₁₁₁.
- (42) 3507¹¹¹¹₁₁₁₁.
- (43) 3871¹¹¹¹₁₁₁₁.
- (44) 2113¹¹¹¹₁₁₁₁.
- (45) 29956¹¹¹¹₁₁₁₁.
- (46) 35232.
- (47) 259¹¹¹¹₁₁₁₁.
- (48) 79140219640482 ;
Seventy-nine billions one
hundred and forty thou-
sand two hundred and
nineteen millions six hun-
dred and forty thousand
four hundred and eighty-
two.
- (49) 38653¹¹¹¹₁₁₁₁.
- (50) 289.
- (51) 133003 ;
One hundred and thirty-
three thousand and three.
- (52) 981064¹¹¹₁₁₁.
- (53) Two hundred and fifteen
thousand, five hundred
and forty-one.
- (54) 9.
- (55) Sum = 190686 ;
Diff. = 189644 ;
Product = 99075965 ;
Quotient = 365.
- (57) 156.

EXERCISE II.—COMPOUND RULES—MONEY.

- | | |
|----------------------------------------------------------------------|------------------------------------------------|
| (1) £10,416, 13s. 4d. | (31) £1835, 1s. 6½d. |
| (2) £4453, 15s. 9d. | (32) £910 — £128, 19s. 4d.
£781, 0s. 8d. |
| (3) 14,161 and 82,380 halfpence. | (33) £4, 10s. 2½d. ¾. |
| (4) 71 half-crowns. | (34) 16s. 6½d. ⅞. |
| (5) 32,046 sixpences ;
18,724 half-crowns. | (35) £176, 18s. 0½d. ⅞. |
| (6) 2 guineas 13s. 0½d ;
220 half-crowns ;
1980 crowns 1s. 6d. | (36) £69, 7s. 6½d. = 66603 far. |
| (7) 18 guineas. | (37) £441, 5s. 3d. |
| (8) 365 loaves. | (38) £28,565, 0s. 3½d. ;
£634, 15s. 6½d. ¾. |
| (9) 16 articles. | (39) £21,272, 15s. 7½d. ;
£761, 2s. 4½d. |
| (10) 670½ yd. | (40) £1950, 0s. 2½d. 9 ;
£7, 2s. 7½d. ⅞. |
| (11) 561. | (41) £11,250, 2s. 3d. ;
£144, 4s. 7½d. ⅞. |
| (12) £9837, 6s. 8d. | (42) £9, 18s. 2½d. ⅞. |
| (13) £28,424, 3s. 2d. | (43) £10,438, 10s. 10½d. ;
£39, 6s. 7½d. |
| (14) £17, 16s. 8½d. | (44) £4921, 19s. 6½d. ;
£5, 11s. 5½d. |
| (15) £258, 10s. 10d. | (45) £8, 17s. 9½d. |
| (16) 27,192 pence. | (46) £6, 5s. 8½d. |
| (17) £4304, 7s. 10½d. | (47) £1, 2s. 6d. |
| (18) £13,244, 5s. 3d. | (48) £2, 9s. 6½d. |
| (19) £90, 4s. 0½d. | (49) £328, 13s. 4d. |
| (20) £5759. | (50) £1, 18s. 1½d. ;
£1, 18s. 0½d. |
| (21) £15,288, 1s. 10½d. | (51) £109, 5s. |
| (22) £2421, 12s. 9½d. | (52) £794, 2s. 2½d. ⅞. |
| (23) £530, 4s. 8½d. | (53) £2275. |
| (24) £8348, 13s. 4½d. | (54) £862, 3s. 9d. |
| (25) £2614, 11s. 1½d. | (55) £337, 10s. |
| (26) £7147, 19s. 4½d. | |
| (27) £2674, 14s. 5½d. | |
| (28) £1473, 9s. 7½d. | |
| (29) 1s. 5d. | |
| (30) £279, 1s. 3d. | |

- | | |
|-------------------------------------------------------------------------------------|-----------------------------------------------|
| (56) A's share, £500, 10s.
B's " £499, 10s. | (59) £48, 11s. 4d. |
| (57) A, £54; B, £41; C, £29. | (60) A possesses £55;
B " £65;
C " £85. |
| (58) A's share = £288, 6s. 8d.;
B's " = £278, 6s. 8d.;
C's " = £272, 16s. 8d. | |

EXERCISE III.—COMPOUND RULES—WEIGHTS AND MEASURES.

- | | |
|-----------------------------------------------|----------------------------------------------------------|
| (1) 9 tons 1 cwt. 3 qr. 11 lb. | (23) 76,040½ sec. |
| (2) 17,108 lb.; 854 oz. | (24) 3 weeks 3 days 21 hr. 20 min. |
| (3) 86,289 lb. 2 oz. 16 dwt. 20 gr. | (25) 319 days 9 hours. |
| (4) 40 lb. 8 oz. 13 dwt. 15 gr. | (26) 236,940 in.; 384,489 sq. ft.; 31,220 lb. |
| (5) 1633½ oz. troy. | (27) 28,892,160 pages. |
| (6) 33½ oz. avoird. | (28) £2,628,000. |
| (7) 1198½ lb. avoird. | (29) 40 portions. |
| (8) 282,702 in. | (30) 237 parcels. |
| (9) 198,666 in. | (31) 56,700 sovereigns. |
| (10) 233,205 in. | (32) 640 times. |
| (11) 284,466 in. | (33) 9660 times. |
| (12) 1578 m. 2 fur. 10 po. 2 yd. 2 ft. 4 in. | (34) 17 tons 7 cwt. 2 qr. 5 lb. |
| (13) 1½ m. 32 po. 2 yd. 2 ft. 3 in. | (35) 16 ac. 26 po. 11½ yd. = 704,144½ sq. ft. |
| (14) 2 m. 5 fur. 37 po. ½ yd. 1 ft. 3 in. | (36) 29 ac. 2 ro. 32 po. = 1,293,732 sq. ft. |
| (15) 2 m. 150 yd. 2 ft. | (37) 140 ac. 3 ro. 10 po. 10½ sq. yd. = 681,542½ sq. yd. |
| (16) 261330½ sq. ft. | (38) The latter by one foot. |
| (17) 17,658,216 sq. in. | (39) 1 week 6 days 3 hr. 52 min. 57 sec. |
| (18) 174 ac. 1 ro. 12 po. 5 sq. yd. 6 sq. ft. | (40) 3090 tons 19 cwt. 1 qr. 21 lb. |
| (19) 98,083½ yd.; £272, 9s. 1½d. | (41) 186 tons 3 qr. 9 lb. 9½ oz. |
| (20) 31,622,400 sec. | |
| (21) 1,798,745,409 sec. | |
| (22) 1 day. | |

- (42) 2363 ac. 1 ro. 9 po. 18½ sq. yd.
 (43) 302 ac. 3 ro. 39 po. 16½ sq. yd. 1 sq. ft. 10½ sq. in.
 (44) 3 lb. 6 oz.
 (45) 2 tons 3 cwt. 1 qr. 19 lb.
 (46) 7 cwt. 1 qr. 21 lb. 3 oz. 5½ dr.
 (47) 54 tons 3 cwt. 2 qr. 24 lb. 10 oz. 7½ dr.
 (48) 3 m. 5 fur. 17 po. 2 yd. 5 in.
 (49) 1 ac. 10 po. 4 sq. yd. 2 sq. ft.
 (50) 3 ac. 2 ro. 19 po. 10 sq. yd. 108 sq. in.
 (51) 131 lb. 1 dwt. 16 gr.; 46 m. 4 fur. 20 po. 4 yd. 1 ft. 4½ in.
 (52) 55 yd.
 (53) 2481 cwt. 12 lb.; £11,785, 5s. 2½d.
 (54) 114 ac. 2 ro.; £429, 7s. 6d.
 (55) 100,010,001 in.
 (56) £833,416, 13s. 6d.
 (57) £1, 6s. 8d.
 (58) £8, 7s. 7½d. ⅓d.
 (59) £7 per ton; 4½d. per oz.; 1s. 10½d. per stone.

EXERCISE IV.—VULGAR FRACTIONS.

- (1) 2×5^4 ; $3^2 \times 5 \times 7^2$.
 (2) $2^3 \times 3^3 \times 7^2$.
 (3) 2, 4, 8, 16, common measures; G.C.M. = 16.
 (4) 21.
 (5) 17640.
 (6) G.C.M. = 25; L.C.M. = 3000.
 (7) G.C.M. = 37; L.C.M. = 4680.
 (8) G.C.M. = 19; L.C.M. = 5544.
 (9) G.C.M. = 11. L.C.M. = 720720.
 (10) $\frac{2}{3}$; $\frac{1}{4}$; $\frac{1}{5}$.
 (11) $\frac{4^5 - 1}{1^5 - 1}$.
 (12) $\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$.
 (13) $2\frac{1}{2}$.
 (14) $\frac{3}{4}$.
 (15) 2.
 (16) $1\frac{1}{10}$.
 (17) $\frac{2}{3}$.
 (18) $\frac{2}{3}$.
 (19) $\frac{1}{3} + \frac{1}{4} + \frac{1}{5} = 1\frac{47}{60}$.
 (20) $15\frac{1}{2}$.
 (21) $18\frac{1}{2}$.
 (22) $\frac{1}{2}$.
 (23) $13\frac{1}{2}$.
 (24) $2 + 8 + 3 = 13$.
 (25) $2\frac{1}{2}$.
 (26) $4\frac{1}{2}$.
 (27) 8½.
 (28) $\frac{1}{2}$ is larger by $\frac{1}{4}$.
 (29) $2\frac{1}{2}$.
 (30) $3\frac{1}{2}$.
 (31) $2\frac{1}{2}$.
 (32) $\frac{1}{2}$.

- (33) $\frac{7}{8}$.
 (34) $1\frac{1}{2}$.
 (35) $7\frac{1}{2}$.
 (36) $8\frac{1}{2}$.
 (37) $26\frac{1}{2}$; $2\frac{1}{2}$.
 (38) $48\frac{7}{8}$; $1\frac{1}{8}$.
 (39) $15\frac{1}{2}$; $2\frac{1}{2}$.
 (40) $\frac{7}{8}$.
 (41) $1\frac{1}{2}$.
 (42) $-\frac{1}{2}$.
 (43) $-\frac{1}{8}$.
 (44) $\frac{1}{2}$.
 (45) $10\frac{1}{2}$.
 (46) $616\frac{1}{2}$.
 (47) (1) $2\frac{1}{2}$; (2) 1.
 (48) $\frac{1}{2}$.
 (49) 10.
 (50) $6\frac{1}{2}$.
 (51) $12\frac{1}{2}$.
 (52) $\frac{1}{2}$.
 (53) $\frac{1}{2}$; $13\frac{1}{2}$.
 (54) $58\frac{1}{2}$; $1\frac{1}{2}$.
 (55) $219\frac{1}{2}$; $3\frac{1}{2}$.
 (56) (1) $32\frac{1}{2}$; (2) $3\frac{1}{2}$.
 (57) $139\frac{1}{2}$; $7\frac{1}{2}$.
 (58) $\frac{1}{2}$.
 (59) $\frac{1}{2}$.
 (60) $3\frac{1}{2}$ times; $1\frac{1}{2}$.
 (61) (1) $\frac{1}{2}$; (2) $3\frac{1}{2}$.
 (62) $\frac{1}{2}$; $\frac{1}{2}$.
 (63) $\frac{1}{2}$.
 (64) $1247\frac{1}{2}$; $34\frac{1}{2}$.
 (65) $2\frac{1}{2}$; 26.
 (66) (1) $40\frac{1}{2}$; (2) $\frac{1}{2}$.
 (67) 7.
 (68) $1\frac{1}{2}$.
 (69) $1\frac{1}{2}$.
 (70) $1\frac{1}{2}$.
 (71) 1.
 (72) (1) $\frac{1}{2}$; (2) 7.
 (73) $1\frac{1}{2}$.
 (74) $1\frac{1}{2}$.
 (75) $1\frac{1}{2}$; $\frac{1}{2}$.
 (76) 13.
 (77) $\frac{1}{2}$; $\frac{1}{2}$.
 (78) 0.
 (79) 1.
 (80) 3.
 (81) 1.
 (82) $\frac{1}{2}$.
 (83) 0.
 (84) (1) $\frac{1}{2}$; (2) $\frac{1}{2}$.
 (85) $\frac{1}{2}$.
 (86) $\frac{1}{2}$.
 (87) $4\frac{1}{2}$.
 (88) (1) $1\frac{1}{2}$; (2) $1\frac{1}{2}$.
 (89) $\frac{1}{2}$.
 (90) $\frac{1}{2}$.
 (92) 5s. 11 $\frac{1}{2}$ d.
 (93) £26, 19s. 11 $\frac{1}{2}$ d. 11 $\frac{1}{2}$ d.
 (94) £21, 14s. 3d.
 (95) 3s. 8 $\frac{1}{2}$ d. 7.
 (96) £3, 5s. 10 $\frac{1}{2}$ d. 7.
 (97) 10s. 11 $\frac{1}{2}$ d. 11 $\frac{1}{2}$ d.
 (98) 4s. 9d.
 (99) £1.
 (100) 658 half-crowns;
 117040 oz.
 (101) £1016, 6s. 3d.
 (102) 1s. 9 $\frac{1}{2}$ d. 7.

- | | |
|-------------------------------------------------------|----------------------------------------------------|
| (103) $\frac{1}{2}$; $\frac{1}{4}$. | (112) £1, 7s. 5½d. $\frac{1}{2}$; $\frac{1}{4}$. |
| (104) $\frac{1}{2}$. | (113) $\frac{1}{2}$; $\frac{1}{4}$. |
| (105) $\frac{1}{2}$. | (114) 7½ hours. |
| (106) $\frac{1}{2}$; $\frac{1}{4}$; $\frac{1}{8}$. | (115) 3½ hours. |
| (107) $\frac{1}{2}$; $\frac{1}{4}$; $\frac{1}{8}$. | (116) £600. |
| (108) $\frac{1}{2}$. | (117) 63 ft. |
| (109) $\frac{1}{2} \div \frac{1}{4} = 4$. | (118) £105. |
| (110) $\frac{1}{2}$; 881:1009. | (119) £631, 11s. 6½d. |
| (111) $\frac{1}{2}$. | (120) 42 miles. |

EXERCISE V.—DECIMAL FRACTIONS.

- | | |
|----------------------------------------------------------------------|-------------------------------------------------|
| (1) .8; .88; .2142857; .26. | (22) .0375 × .035 = .0013125. |
| (2) 7.6875; 4.285714. | (23) 1.5625 × .002816 = .0044. |
| (3) .12; .0571428; .01. | (24) .003375. |
| (5) $\frac{1}{2}$; .02. | (25) .18636 = $\frac{1}{5}$. |
| (6) $\frac{1}{2}$; $\frac{1}{4}$; $\frac{1}{8}$; $\frac{1}{16}$. | (26) 44.253432. |
| (7) $\frac{1}{2}$; $\frac{1}{4}$; $\frac{1}{8}$. | (28) $1\frac{1}{2} \times \frac{1}{2} = 1$. |
| (8) .625; .285714; .7; | (29) .06625 - .0625 = .00375 = $\frac{1}{26}$. |
| $\frac{1}{2}$; $\frac{1}{4}$; $\frac{1}{8}$. | (30) 63.4955; 81.60118. |
| (9) 1.2; .571428; 31.415926. | (31) .0000214849568 + ; $\frac{1}{2}$. |
| (10) .06640625; $\frac{1}{2}$. | (32) $\frac{1}{2}$; .000073. |
| (11) .4625; .857142; | (33) .05571 + |
| $\frac{1}{2}$; $\frac{1}{4}$; $\frac{1}{8}$. | (34) .004096. |
| (12) .142857; 3.14159292; | (35) .0005307 + |
| $\frac{1}{2}$; $\frac{1}{4}$. | (36) .010193 + |
| (13) $\frac{1}{2}$. | (37) 6366197.41 + |
| (14) 400.2722. | (38) .09875. |
| (15) 28.981. | (39) (1) 1.045678375; (2) 220. |
| (16) 21.491. | (40) 4.01. |
| (17) 389.03. | (41) 284.3053407; 4567000. |
| (18) .81 = $\frac{81}{100}$. | (42) 2.81; 632.8. |
| (19) 22.960431. | (43) 95.01620414 + |
| (20) .0012571428; .00000707 + | (44) .058. |
| (21) 112.111; 11.323211. | |

- (45) 1.2138; 50.
 (46) .0000006.
 (47) $110990.775 \div 133.9 =$
 $828.907 +$
 (48) 14.
 (49) 5.1831715.
 (50) .79514716.
 (51) 1.111; 12.285714.
 (52) .006.
 (53) .03.
 (54) 849.28.
 (55) .24131; .05.
 (56) 1.8229 +
 (57) (1) 6.992304; (2) 106.82521;
 $7566.11842105.$
 (58) 329.5233875; 1035.0692391.
 (59) .91875; .2.
 (60) $\frac{1}{8}$; .003125.
 (61) .17857142.
 (62) $\frac{1}{4}$; .175.
 (63) .22916; .008402203856 +
 (64) $\frac{27}{80}$; .04440789 +
 (65) .046340629 +
 (66) .259; 1.428571.
 (67) .06; .07.
 (68) 3.3135416; 66.27083;
 $1590.5.$
 (69) 11s. 4½d. $\frac{1}{2}$; 1 qr. 14 lb.
 (70) 9s. 2d.
 (71) .065625; 1s. 3½d.
 (72) £5.
 (73) 4½d. $\frac{1}{2}$ + 9d. - $\frac{3}{4}$ $\frac{1}{2}$ = 1s. 1d.
 (74) 17s. 6½d. + 7s. 10½d. -
 $5s. 4½d. = £1, 0s. 0½d.$
 (75) £6, 7s. 6d.
 (76) $\frac{1}{8}$; £17, 10s. 7½d.
 (77) £3, 4s. 6d. - 12s. 6d. +
 $£1, 8s. 11d. = £3, 15s. 11d.$
 (78) 52.5 lb.
 (79) £2, 6s. 0½d. + 2s. 3d. -
 $6s. 10d. + £1, 3s. 10½d. =$
 $£3, 5s. 4½d.$
 (80) .75.
 (81) $\frac{10s. 6d.}{£250} = .0021.$
 (82) .2; .17 cwt. 1 qr. 22 lb.
 $6 \text{ oz. } 6.4 \text{ dr.}$
 (83) 2s. 6d. + 11½d. + 3½d. =
 $3s. 9d.; .1875.$
 (84) £514, 16s. = £514.8.
 (85) £911, 9s. 2d.
 (86) .0004375.
 (87) 1.336.
 (88) .325.
 (89) .74625.
 (90) .0078125.
 (91) .228125; 2 fur. 21 po. 1 yd.
 $2 \text{ ft. } 6 \text{ in.}; 2 \text{ ro. } 7 \text{ po.}$
 $15 \text{ yd. } 6 \text{ ft. } 82.08 \text{ in.}$
 (92) $\frac{1}{16}$; £3.8822916.
 (93) .00505; .
 $358.8235294117647058;$
 $£12.7322916.$
 (94) 41.4; 1000 lb.
 (95) .18988; .25; 8s. 4d.
 (96) £12.68125; £12.681, 5s.
 $£9.4885416; £9488, 10s. 10d.$
 (97) 17.608 pt.; 16.0673 gal.
 (98) .363696.
 (99) $2\frac{1}{1000000}$.
 (100) 1400 yd.

EXERCISE VI.—SIMPLE PROPORTION.

- | | |
|-----------------------------------------------|-----------------------------------------|
| (1) 135 sheep. | (31) 2 min. |
| (2) £4, 18s. 2½d. ⅓. | (32) 154 miles 4 fur. 21¼ po. |
| (3) 17 yd. | (33) 123¼. |
| (4) 365 days. | (34) 43 lb. 6 oz. 5 dwt. 7½ gr. |
| (5) £66, 12s. | (35) 5236½ francs. |
| (6) £74, 6s. 9d. | (36) 24 days. |
| (7) £164, 16s. 10½d. | (37) 8½ days. |
| (8) £85, 12s. 10½d. ¼. | (38) 2 lb. 8½ oz. |
| (9) £16, 16s. | (39) 200 miles. |
| (10) The latter by ¾d. | (40) 3312 yd. |
| (11) £52, 9s. 6⅔d. | (41) 2512 times. |
| (12) 11 qr. 14 lb. | (42) 1 hour 12 min. |
| (13) 151⅔ ml. | (43) 16½ oz. |
| (14) £4, 8s. | (44) 4d. |
| (15) 6958½ francs. | (45) 6d. |
| (16) £3, 12s. 6d. | (46) 1s. 3d. |
| (17) 1 qr. 13½ lb. | (47) £125, 10s. 10d. |
| (18) £155, 10s. 7½d. | (48) £767. |
| (19) 9763⅓. | (49) £462. |
| (20) £14, 1s. 8d. | (50) £279, 13s. 4d. |
| (21) £27, 17s. 2½d. ⅔. | (51) £2, 18s. 4d. |
| (22) 7 hours 45 min. | (52) £380. |
| (23) 15s. 9½d. ⅓. | (53) £650. |
| (24) 10 qr. 3 lb. 8 oz. | (54) £360. |
| (25) 23 lb. 9 oz. 12 dwt;
£69, 0s. 4½d. ⅓. | (55) 7s. 7½d. ⅓; ⅓; ⅓;
38½ per cent. |
| (26) 44 ft. | (56) 4200. |
| (27) 5½ yd. | (57) £263, 10s. 10d. |
| (28) 9.90. | (58) £1, 2s. 8½d. |
| (29) 132. | (59) 253½ lb. |
| (30) 2 hours 45 min. 4⅓ sec. | (60) £3, 19s. 0½d. |

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|-----------------------------------------------------------|-------------------------------------------------|
| (61) 78 yd. | (76) 4389·039 + metres. |
| (62) $537\frac{1}{2}$ yd. ; £89, 11s. 8d. | (77) 1·344 farthings. |
| (63) £3, 2s. $8\frac{1}{2}$ d. $\frac{1}{12}\frac{1}{12}$ | (78) £378. |
| (64) $859\frac{1}{4}$ lb. | (79) 1s. |
| (65) 4 hours $23\frac{1}{11}$ min. | (80) £568, 3s. $7\frac{1}{2}$ d. $\frac{1}{11}$ |
| (66) 3850 miles 4 fur. $26\frac{1}{2}$ po. | (81) 24 days. |
| (67) $7\frac{1}{8}$ days. | (82) $115\frac{1}{2}$ yd. |
| (68) 48 miles. | (83) 176 steps. |
| (69) 65 hours. | (84) 110 yd. |
| (70) 15·2856 min. | (85) $6\frac{1}{2}$ d. |
| (71) £116, 0s. $5\frac{1}{2}$ d. $\frac{1}{4}$. | (86) 4.30 A.M. on March 13. |
| (72) £41, 17s. $10\frac{1}{2}$ d. $\frac{1}{4}$. | (87) 48 lb. 2 oz. |
| (73) 111837·176 metres. | (88) $5\frac{5}{8}$ yd. |
| (74) $359\frac{1}{2}$ lb. | (89) 10 hours ; 400 miles. |
| (75) £897, 3s. $7\frac{1}{2}$ d. $\frac{1}{4}$. | (90) 112 miles. |

EXERCISE VII.—COMPOUND PROPORTION.

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|-----------------------------|---------------------------------------------------|
| (1) 16 men. | (16) 273 miles. |
| (2) £1, 16s. | (17) £86, 12s. 6d. |
| (3) 7 months. | (18) $23\frac{1}{11}$ days. |
| (4) 5 men. | (19) 54 men. |
| (5) 34 miles. | (20) $52\frac{1}{11}$ pages. |
| (6) $10\frac{1}{2}$ days. | (21) £1, 4s. $4\frac{1}{2}$ d. . |
| (7) $261\frac{1}{2}$ miles. | (22) £1443, 4s. $3\frac{1}{2}$ d. $\frac{1}{4}$. |
| (8) 21s. | (23) 30 men. |
| (9) 30 men. | (24) 51 days. |
| (10) £33. | (25) 8 women. |
| (11) $7\frac{1}{2}$ days. | (26) 17·88. |
| (12) £142, 10s. | (27) 1s. $5\frac{1}{2}$ d. |
| (13) $8\frac{1}{8}$ days. | (28) £2000. |
| (14) £15, 3s. 4d. | (29) $9\frac{1}{2}$ yd. |
| (15) $5\frac{1}{2}$ days. | (30) 190 yd. |

EXERCISE VIII.—PRACTICE AND BILLS OF PARCELS.

(1) £1289, 16s. 8d.		£ s. d.
(2) £2368, 9s. 7d.	(25)	10 19 9
(3) £7061, 17s. 3d.		27 15 4
(4) £13,658, 12s. 5d.		61 5 0
(5) £27,538, 17s. 3d.		<u>£100 0 1</u>
(6) £4045, 10s. 9½d.	(26)	2 3 11½
(7) £3935, 14s. 7½d.		12 2½
(8) £7526, 9s.		1 0 5
(9) £2677, 15s. 10½d.		19 2
(10) £3171, 7s. 3½d.		<u>£4 15 8½</u>
(11) £596, 0s. 5½d. ½.	(27)	43 8 9
(12) £91,949, 1s. 10½d. ½.		9 14 0½
(13) £144,836, 3s. 9½d.		30 19 6
(14) £166, 6s. 2½d. ⅔.		<u>£84 2 3½</u>
(15) £14,447, 12s. 7½d.	(28)	1 10½
(16) £1688, 2s. 8d.		1 5 10
(17) £3304, 8s. 4½d. ¼.		3 11 4½
(18) £1895, 19s. 9½d. ⅓.		9 6
(19) £770, 7s. 3½d. ½.		<u>£5 8 7</u>
(20) £31, 5s.	(29)	83 5 0
(21) £8092, 11s. 5½d.		99 11 0
(22) £198, 4s. 3d.		35 3 9½
(23) £425, 6s. 7½d. ⅓.		<u>£217 19 9½</u>
	(30)	1193 16 8
		1208 13 8½
		77 16 11
		<u>£2480 7 3½</u>
		Rebate £124 0 4½
(24)		
s. d.		
8 6½		
4 6		
4 8½ ½		
4½		
9½ ½		
<u>18 10½ ⅓</u>		

EXERCISE IX.—DISTRIBUTIVE PROPORTION.

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|------------------------------------------------------------------|----------------------------------------------------------------------------------|
| (1) 20; 60; 80. | (15) £6738; £5615; £4492;
£3360. |
| (2) £9, 3s.; £12, 4s.; £15, 5s. | |
| (3) £266, 13s. 4d.; £400;
£533, 6s. 8d. | (16) 235 $\frac{1}{11}$ m. from London;
169 $\frac{1}{11}$ m. from Edinburgh. |
| (4) £47, 5s.; £78, 15s.; £110, 5s. | (17) £421, 8s.; £451, 10s. |
| (5) £25, 17s. 1d.; £58, 3s. 5 $\frac{1}{2}$ d.;
£77, 11s. 3d. | (18) £202, 10s.; £225; £281, 5s. |
| (6) £4, 14s.; £9, 8s.; £14, 2s. | (19) £70; £40; £10. |
| (7) £112, 10s.; £87, 10s.;
£137, 10s. | (20) 7 pounds, 21 shillings,
28 pennies. |
| (8) £600; £633, 6s. 8d.; £700. | (21) 7 sovereigns, 14 half-crowns,
35 shillings, 70 three-
pennies. |
| (9) £150; £210; £360. | (22) 66 crowns, 44 shillings,
22 pennies. |
| (10) £87, 5s.; £47, 15s. | (23) £3; £10, 10s.
Each boy gets 3s. |
| (11) £46, 5s.; £75, 5s.; £105, 10s. | (24) £500; £400. |
| (12) £39, 18s.; £63, 12s.;
£97, 10s. | (25) 4 miles; 3 $\frac{1}{2}$ miles. |
| (13) £7, 10s.; £15; £33, 15s. | |
| (14) £9; £11, 5s.; £13, 10s. | |

EXERCISE X.—SIMPLE INTEREST.

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|-----------------------------------|--------------------------------------------------------|
| (1) £63, 7s. | (13) £90, 16s. 11 $\frac{1}{2}$ d. 7 $\frac{1}{2}$ ¢. |
| (2) £616, 14s. | (14) £11, 14s. 0 $\frac{1}{2}$ d. 1 $\frac{1}{2}$ ¢. |
| (3) £112, 10s. | (15) £3, 3s. 10 $\frac{1}{2}$ d. |
| (4) £244, 10s. 7 $\frac{1}{2}$ d. | (16) £11, 11s. 8 $\frac{1}{2}$ d. 1 $\frac{1}{2}$ ¢. |
| (5) £56, 18s. 4d. | (17) £3, 0s. 3 $\frac{1}{2}$ d. + |
| (6) £25, 0s. 7 $\frac{1}{2}$ d. | (18) £455. |
| (7) £43, 11s. 6 $\frac{1}{2}$ d. | (19) £720. |
| (8) £61, 5s. | (20) £496, 13s. 4d. |
| (9) £350. | (21) £700. |
| (10) £43, 11s. 6d. | (22) £1116, 15s. 6 $\frac{1}{2}$ d. 1 $\frac{1}{2}$ ¢. |
| (11) £545. | (23) £960, 12s. 6 $\frac{1}{2}$ d. 1 $\frac{1}{2}$ ¢. |
| (12) £461, 5s. | (24) £14,805. |

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|-------------------------------------------------------|---------------------------------------------------|
| (25) £875. | (31) August 21. |
| (26) £875 ; £175. | (32) $4\frac{1}{2}$ per cent. |
| (27) £36,212, 11s. $11\frac{1}{2}$ d. $\frac{2}{3}$. | (33) $6\frac{1}{2}$ per cent. |
| (28) $3\frac{1}{2}$ years. | (34) 3 per cent. |
| (29) $4\frac{1}{2}$ years. | (35) £998, 15s. |
| (30) $37\frac{1}{2}$ years. | (36) £106, 5s. $\div 25 = 4\frac{1}{2}$ per cent. |

EXERCISE XI.—PROFIT AND LOSS.

- | | |
|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| (1) £41, 13s. 4d. | (27) £19, 0s. $11\frac{1}{2}$ d. $\frac{1}{2}$;
£20, 19s. $0\frac{1}{2}$ d. $\frac{1}{2}$. |
| (2) £1591, 8s. $11\frac{1}{2}$ d. ;
£282, 6s. $5\frac{1}{2}$ d. | (28) £2, 13s. $6\frac{1}{2}$ d. $\frac{1}{2}$;
£2, 19s. $11\frac{1}{2}$ d. $\frac{1}{2}$. |
| (3) $10\frac{1}{2}$ per cent. | (29) 44 per cent. |
| (4) $42\frac{1}{2}$ gain per cent. | (30) £2150. |
| (5) 5s. ; 50 per cent. | (31) 25 per cent. |
| (6) 25 per cent. | (32) 3s. $3\frac{1}{2}$ d. $\frac{1}{2}$. |
| (7) $3\frac{1}{2}$ per cent. | (33) $37\frac{1}{2}$ per cent. gain. |
| (8) $48\frac{9}{10}$ per cent. $181\frac{7}{8}$ yd. | (34) 14 per cent. |
| (9) 4s. 2d. | (35) 10 per cent. |
| (10) £54. | (36) £150. |
| (11) £337, 14s. 2d. | (37) 40 per cent. loss. |
| (12) 7s. 6d. | (38) 70 per cent. |
| (13) £471, 7s. $4\frac{1}{2}$ d. $\frac{1}{2}$. | (39) £1, 1s. $9\frac{1}{2}$ d. |
| (14) £1388, 17s. $9\frac{1}{2}$ d. $\frac{1}{2}$. | (40) £274, 4s. $7\frac{1}{2}$ d. $\frac{1}{2}$. |
| (15) 6191.7364 + | (41) £125. |
| (16) £1120. | (42) £92. |
| (17) 123 grains. | (43) 8s. $0\frac{1}{2}$ d. |
| (18) £1489, 6s. 3d. ; £1191, 9s. | (44) 15 eggs. |
| (19) 2 per cent. gain. | (45) £847,499, 11s. $6\frac{1}{2}$ d. increase. |
| (20) 14 per cent. gain. | (46) $2\frac{1}{2}$ per cent. loss. |
| (21) $7\frac{1}{2}$ per cent. loss. | (47) £16, 12s. $0\frac{1}{2}$ d. |
| (22) $\frac{1}{2}$ per cent. gain. | (48) £1, 10s. |
| (23) $3\frac{1}{2}$ per cent. gain. | (49) 17s. 3d. ; $13\frac{1}{2}$ gal. |
| (24) £1, 4s. | (50) 9.87 per cent. |
| (25) 5s. 6d. | |
| (26) £102, 6s. | |

EXERCISE XII.—COMPOUND INTEREST.

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|-----------------------------------|------------------------------|
| (1) £231, 10s. 6d. | (12) £65, 18s. 0½d. ½. |
| (2) £390, 4s. | (13) £6, 13s. 11½-752d. |
| (3) £175, 14s. 11.0592d. | (14) £42, 1s. 0.12d. |
| (4) £1579, 6s. 2.17344d. | (15) £1407, 2s. 0.101d. + |
| (5) £169, 17s. 2.0544d. | (16) £118. |
| (6) £1215, 10s. 1½d. | (17) £5, 12s. 4.85d. + |
| (7) £29, 11s. 2⅞d. | (18) £900. |
| (8) £133, 2s. 9½-589 + | (19) £839, 12s. |
| (9) (1) £60; (2) £62, 8s. 7.68d. | (20) Less; Compound interest |
| (10) £2792, 13s. 8½d. ⅞s. | = 2s. 5½-86944d.; |
| (11) Simple interest by 3s. 6.4d. | 5s. 3½d. |

EXERCISE XIII.—DISCOUNT.

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|----------------------------------|------------------------|
| (1) £1848. | (11) £2, 11s. |
| (2) £160, 16s. 2½d. ⅓. | (12) 7d. nearly. |
| (3) £387, 17s. 0½d. ⅞s. | (13) £2651. |
| (4) £480, 17s. 11½d. ⅔s. | (14) 4½ per cent. |
| (5) £520, 7s. 1¼d. | (15) 5 per cent. |
| (6) £906, 6s. 9½d. ⅔s. | (16) 5 months hence. |
| (7) £1, 18s. 10⅞d. | (17) £1525. |
| (8) £87, 2s. 6d. | (18) £4, 18s. 7d. ⅓. |
| (9) £12, 12s. 2½d. ⅔; | (19) £742, 16s. 1d. ⅔. |
| £10, 8s. 8½d. ⅓. | (20) 5½-⅔-⅓-⅓d. |
| (10) £449, 8s. 9d. ⅓; £443, 15s. | |

EXERCISE XIV.—STOCKS.

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|------------------------------------|--------------------------------|
| (1) £1041, 13s. 4d.; £41, 13s. 4d. | (8) The latter. |
| (2) £280, 12s. 2½d. ⅓. | (9) Bank stock. |
| (3) £588. | (10) The latter; £50. |
| (4) £15, 7s. 6d. | (11) 75 per cent. |
| (5) £324. | (12) £9250; £8556, 5s. |
| (6) £97½. | (13) £40. |
| (7) A £3, 6s. 8d.; B £3, 7s. 8⅞d. | (14) 640 shares; £20 increase. |

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|--------------------------------------|------------------------|
| (15) £985; £34, 0s. 10½d. ⅞. | (21) £89, 13s. 9d. |
| (16) £77, 10s.; £5, 8s. | (22) £240, 3s. 0½d. ⅓. |
| (17) £44, 5s. increase. . | (23) £1, 19s. loss. |
| (18) £3239, 3s. 4d.; £3263, 16s. 3d. | (24) £4.46 per cent. |
| (19) £18, 1s. 6½d. increase. | (25) £19,228. |
| (20) £2940. | |

EXERCISE XV.—RECTANGULAR SURFACES AND SOLIDS.

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|--------------------------------|------------------------------------|
| (1) £13, 6s. 8d. | (16) 87 yd.; 4959 cub. ft. |
| (2) £261,360. | (17) £1, 4s. 6d. |
| (3) 5⅞ ac.; £11, 9s. 6d. | (18) 132 scholars. |
| (4) 64 yd. | (19) 760,320 blocks. |
| (5) 2000 tiles. | (20) 10,000 blocks. |
| (6) 15s. 2d. | (21) 22,624⅓⅓ gal. |
| (7) £1, 6s. 6d. | (22) 8,960,000 cub. ft. |
| (8) 20½ ft. | (23) 7680 yd. |
| (9) 236⅓ yd. | (24) 6 ft. |
| (10) 25 yd. | (25) 24½ yd. carpet; 20 yd. tape. |
| (11) 4½ ft. | (26) £21, 11s. 0½d.; £6, 19s. 8½d. |
| (12) 70½ yd.; £11, 15s. 6½d. ⅓ | (27) 3s. 2½d. |
| (13) 5½ yd. | (28) 135 miles; 180 hr. |
| (14) 72 yd. | (29) 17½ ft. |
| (15) 393½ yd. | (30) 4 tons 9 cwt. 1 qr. 17⅓⅓ lb. |

EXERCISE XVI.—SQUARE ROOT AND CUBE ROOT.

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|------------------------|--------------------------|
| (1) 572. | (10) .1679; 2⅞; 5.0722 + |
| (2) 673. | (11) .948 + |
| (3) 5.76. | (12) 1.932 — |
| (4) 1.00505. | (13) 2.788 +; 8.819 + |
| (5) .03006009. | (14) 937.4410 + |
| (6) (1) 3005; (2) 14½. | (15) .97182 + |
| (7) 3 ft. 9 in. | (16) 2236.06 + |
| (8) .135; 40.61. | (17) 723 ft. |
| (9) 39.37. | (18) .7905; 1.2649; 1. |

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|-------------------------------|-----------------------|
| (19) .67446 + | (25) 120 ft. |
| (20) 2.236 ; 2.645 ; 5.91422. | (26) 14.01517 ; .859. |
| (21) .7906 nearly. | (27) 1.73205 ; 816. |
| (22) 2750 yd. | (28) 19377 ; 547. * |
| (23) .866 ; 31.176. | (29) 234 ; 2.64575. |
| (24) 180 ft. | (30) 18018. |

EXERCISE XVII.—MISCELLANEOUS EXAMPLES.

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|--------------------------------------------------|--------------------------------------------------------------------------------|
| (1) 1, 2, 3, 5, 7, 11, 13, 17, 19, 23. | (28) 2709 centimetres. |
| (2) 8s. 9d. | (29) 25 miles. |
| (3) $1\frac{1}{2}$. | (31) $39\frac{1}{11}$ min. past 4. |
| (4) £2, 1s. 8d. | (32) 2 gal. ; 10 gal. ; 14 gal. |
| (5) 5 months. | (33) £40. |
| (7) $4\frac{1}{2}$ miles per hour. | (34) 3s. 9d. |
| (8) 1 lb. at 4s. ; 2 lb. at 3s. | (35) 297600000. |
| (9) £35, 14s. $10\frac{1}{2}$ d. $\frac{1}{2}$. | (36) 14.732874458. |
| (10) $1\frac{1}{2}$ days. | (37) $3\frac{1}{11}$ days ; $4\frac{1}{11}$ days. |
| (11) £4, 15s. $2\frac{1}{2}$ d. $\frac{1}{2}$. | (38) $35\frac{1}{2}$ sq. yd. ; $1\frac{1}{2}\frac{1}{2}\frac{1}{2}$ ac. |
| (12) 10.8125. | (39) $\frac{1}{4}$. |
| (13) 11.619187 + | (40) $10\frac{1}{11}$ sec. ; $2\frac{1}{11}$ sec. |
| (14) 6 hours. | (41) $\frac{5-4}{7-5}$; $\frac{5 \times 4}{7 \times 5}$; $\frac{5+4}{7+5}$; |
| (15) 1097393685. | $\frac{5 \div 4}{7 \div 5}$ |
| (16) 36 bars. | (42) £2500. |
| (17) £2. 17s. $10\frac{1}{2}$ d. | (43) $1\frac{1}{11}$; 22506. |
| (18) $5\frac{1}{11}$ yd. | (44) 546 inhabitants. |
| (19) 270 francs 75 centimes. | (45) 4.30 P.M. |
| (20) 127 ; 131 ; 137 ; 139. | (46) £1, 2s. |
| (21) 1. | (47) $1\frac{1}{11}\frac{1}{11}\frac{1}{11}$. |
| (22) 8.68089. | (48) 5,260,320 min. ; 144 min. |
| (23) 30 workmen. | (49) 50 gulden. |
| (24) $43\frac{1}{11}$ min. past 11. | (50) £360 ; £480 ; £576 ; £648. |
| (25) $3\frac{1}{11}$ days. | (51) £108, 1s. 3d. ; £129, 13s. 6d. ; |
| (26) 6.26 A.M. | £163, 12s. 9d. |
| (27) 200 oranges. | |

- (52) 1.42375 in.
 (53) $15\frac{1}{2}$ miles.
 (54) $184\frac{1}{4}$ yd.
 (55) £12, 0s. 4d.
 (56) When it is less than unity.
 (58) $\frac{1}{2}$.
 (59) £10,652, 3s. $5\frac{1}{4}$ d.
 (60) £2475; £3375.
 (61) $4\frac{1}{2}$ hours; $13\frac{1}{2}$ m.; $15\frac{1}{2}$ m.
 (62) $3\frac{1}{2}$ per cent.
 (63) $\frac{1}{15}$; $\frac{7}{12}$; sum = $\frac{11}{20}$.
 (64) $2\frac{1}{2}$ hours.
 (65) 5.
 (67) 70 ac. 1 ro. 10 po.
 (69) £1290, 8s.
 (70) 350; 560.
 (71) $3\frac{1}{2}$ per cent.
 (72) 5s. 5.19d.
 (73) 26 miles.
 (75) $5\frac{1}{11}$.
 (76) 6,748,000 cub. ft.;
 421,750,000 lb.
 (77) $12\frac{1}{2}$ per cent. increase.
 (78) 1 min. $47\frac{1}{4}$ sec.;
 $9\frac{1}{4}$ sec.
 (79) $97\frac{1}{2}$.
 (80) $11\frac{1}{2}$ hours; $46\frac{1}{2}$ miles.
 (81) 85 per cent.
 (82) .2777 francs.
 (83) 270.88 centimetres.
 (84) 39.
 (85) $6\frac{1}{2}$ hours; $29\frac{1}{2}$ miles.
 (86) 85 rows.
 (88) $\frac{1}{2}$.
 (89) A will be first.
 (90) $9\frac{1}{11}$ min. past 8.
 (91) 3 for 2d.
 (92) A and C reach the post together; B $\frac{1}{7}$ min. behind them.
 (93) 3.384.
 (94) 10 miles.
 (95) 1.
 (96) 255391.6.
 (97) 1.64025 +
 (98) .9296 per cent.; 52007.27.
 (99) £66.
 (100) Tuesday; 15 times.

EXERCISE XVIII.—ADDITIONAL EXAMPLES.

SET (a).

- (1) 992.
 (2) 9d.
 (3) (1) 42 sq. yd. 2 sq. ft. 36 sq. in.; (2) £5, 2s. $4\frac{1}{2}$ d.
 (4) 2.6.
 (5) £1458.
 (6) 508.048289734 +
 (7) $5\frac{1}{2}$ months.
 (8) 15s. $2\frac{1}{2}$ d.
 (9) $\frac{7}{15}$.
 (10) £1, 5s. 6d.
 (11) (a) $10\frac{1}{11}$; (b) $11\frac{1}{11}$;
 (c) $16\frac{1}{11}$.
 (12) 1141 tons 6 cwt. 1 qr. 9.36 lb.
 (13) 10 per cent.

- | | |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------------|
| (14) 4d. | (39) £19, 16s. 10 $\frac{1}{4}$ d. |
| (15) £32,000. | (40) £2, 8s. 9d. |
| (16) 36930.5. | (42) 4 $\frac{1}{2}$ per cent. gain. |
| (17) £67, 14s. 2d. | (43) 9.18 $\frac{1}{4}$ P.M. |
| (18) £7, 0s. 1d. | (44) 5.91807 .01870. |
| (19) 10 min. 54 $\frac{1}{4}$ sec.;
43 min. 38 $\frac{3}{4}$ sec. | (45) £10,210, 5s. 0 $\frac{1}{2}$ d. |
| (20) .002744; .05238 + | (46) 4 min. 26 $\frac{1}{2}$ sec. |
| (21) £6, 5s. 11 $\frac{1}{2}$ d. | (47) £667, 5s. 10 $\frac{1}{4}$ d. |
| (22) Equal quantities of all three. | (48) £12, 18s. 11d. |
| (23) $\frac{1}{18}$ or .08 $\frac{1}{3}$. | (49) $\frac{1}{18}$. |
| (24) £5, 7s. 9 $\frac{1}{4}$ d. | (50) 56.046875 qr. |
| (25) £9, 0s. 10d. | (51) 112 $\frac{1}{4}$ lb. |
| (26) 9d. | (52) 23 cwt. 2 qr. 15 $\frac{1}{4}$ lb. |
| (27) £4, 6s. 1 $\frac{1}{2}$ d. lost. | (53) 89 hours 59 $\frac{1}{2}$ min. after. |
| (28) .015016142857. | (54) 475,200 times. |
| (29) £1250. | (55) 5 \times 7 \times 11 \times 13. |
| (30) £22,222, 4s. 5 $\frac{1}{2}$ d. | (56) 9 $\frac{1}{2}$ hours. |
| (31) 7s. 6d. | (57) 2 $\frac{1}{4}$. |
| (32) .0353 + | (58) £13, 10s. 9 $\frac{1}{2}$ d. |
| (33) £28, 1s. 4 $\frac{1}{2}$ d. a man's share;
£14, 0s. 8 $\frac{1}{2}$ d. a boy's share. | (59) 353.5 cub. ft. |
| (34) 12 $\frac{1}{2}$ per cent. gain. | (60) 2.091 per cent. |
| (35) 17s. 6d. | (61) 1 $\frac{1}{2}$; 1 ft. 8 in. |
| (36) 35 days. | (62) (1) 32 yd. from the post;
(2) 16 $\frac{1}{2}$ " " |
| (37) (1) a recurring decimal;
(2) 16. | (63) £600; £450; £525; £175. |
| (38) 14 $\frac{1}{2}$ miles. | (64) 10 $\frac{1}{4}$ per cent. |
| | (65) 23 \times 31 \times 37; 26404. |
| | (66) 42 times; $\frac{1}{2}$ of a mile. |

SET (b).

- | | |
|------------------------|------------------------------------|
| (1) 15 rupees. | (7) £83; £47; £14. |
| (2) 402.178. | (8) £1250; 7d. |
| (3) 5 dozen each time. | (9) £4, 10s. |
| (4) 50 additional men. | (10) (1) 13 $\frac{1}{4}$; (2) 1. |
| (5) 1. | (11) 6 $\frac{1}{4}$ days. |
| (6) 22 $\frac{1}{4}$. | (12) 30 per cent. |

- | | |
|---------------------------------------------------------------------------------------------|--------------------------------|
| (13) 385½ sq. yd. | (28) £3 lost. |
| (14) 20.85. | (29) ⅓. |
| (15) £520. | (30) 800 lb. = 7 cwt. 16 lb. |
| (16) £993, 12s. | (31) 3904386 × . |
| (17) £400; £300; £200. | (32) £8704 in each. |
| (18) £924, 11s. 1⅓d. | (33) 11.01. |
| (19) 28½ per cent. | (34) 1 mile an hour. |
| (20) Wine : Water :: 9 : 31. | (35) 7½ per cent. gain. |
| (21) 39.370. | (36) 17⅓ per cent. |
| (22) 43⅓ per cent. | (37) 4 per cent. loss. |
| (23) Discount, £120, 0s. 3d. ;
Interest, £123, 12s. 3⅓d. ;
Debtor loses £3, 12s. 0⅓d. | (38) 525 per cent. |
| (24) Wine : Water :: 13 : 71. | (39) £906. |
| (25) £10, 7s. 7½d. or
£10.3812890625 per cent. | (40) A would win by 21½ yd. |
| (26) 12363. | (41) 450 miles. |
| (27) 2½ miles to an in. | (42) 6 per cent. |
| | (43) 58.25547 + |
| | (44) £70 - £60, 12s. = £9, 8s. |

SPECIMEN EXAMINATION PAPERS.

I. LOCAL PRELIMINARY ARITHMETIC.

EDINBURGH, June 1886.

- (1) 295.5263223 ; 9.8706.
 (2) 2½.
 (3) 983 ; 5277433.
 (4) £476, 9s.
 (5) 810 yd.
 (6) 3952.4 ac.
 (7) £55, 12s. 8d. ; £27, 16s. 4d. ;
 £13, 18s. 2d.

GLASGOW, May 1886.

- (1) 393556658 ; 1435⅓⅓⅓.
 (2) 223 tons 15 cwt. 1 qr.
 £18, 14s. 5½d.
 (3) 215 sovereigns.
 (4) 28⅓⅓ ; ⅓.
 (5) 34⅓⅓ ; 1⅓⅓.
 (6) ⅓⅓.
 (7) £86, 5s. 11½d.
 (8) £42, 18s. 11½d.

ABERDEEN, June 1886.

- (1) Three millions seven thousand and nineteen; 1996994.
- (2) 210 and remainder 30.
- (3) £139, 18s. 3d.
- (4) 6s. 3d.; 320 lb.
- (5) $9\frac{1}{4}$.
- (6) $\cdot 020016$; (a) 400; (b) $\cdot 0004$; $\frac{1}{16}$, $\frac{1}{16}$, $\frac{1}{16}$.
- (7) £3, 2s. 6d.
- (8) 11 times; $\cdot 0\dot{9}$.

ST ANDREWS, June 1886.

- (1) Twenty millions three hundred and four thousand and five; 63600003.
- (2) £2474, 16s. 5 $\frac{1}{2}$ d.
- (3) £103,239, 10s. 1 $\frac{1}{2}$ d.
- (4) 512,896 drams.
- (5) 1 ro. 27 po. 2 yd.
- (6) $\frac{1}{16}$.
- (7) £406, 14s. 4 $\frac{1}{2}$ d.
- (8) 3s. 4 $\frac{1}{2}$ d. $\frac{1}{4}$; £250.
- (9) 8 $\frac{1}{2}$ months.

EDINBURGH, June 1887.

- (1) 3864-367038; 102-05.
- (2) $7\frac{1}{16} = 7\cdot 11\dot{6}$.
- (3) 71; 103740.
- (4) £212, 15s. 10d.
- (5) £47, 6s. 0 $\frac{1}{2}$ d. $\frac{1}{4}$.
- (6) 10s; £6; £15.
- (7) £260.

GLASGOW, May 1887.

- (2) 186688452; 2692, ~~444~~ $\frac{1}{16}$.
- (3) £17411, 6s. 8d.; $\frac{1}{16}$.
6 cwt. 3 qr. 14 lb.
- (4) £1902, 8s. 2d.
- (5) $13\frac{1}{4}$; $2\frac{1}{4}$.
- (6) $111\frac{1}{4}$; $14\frac{1}{4}$.
- (7) £268, 16s.; 40 days.
- (8) $17\frac{1}{4}$ days.

ABERDEEN, June 1887.

- (1) £1646, 11s. 3d.
- (3) 252.
- (4) $\frac{1}{16}$.
- (5) 4d.; $\cdot 0243+$
- (6) $\cdot 0303812$; 230-1.
- (7) 6 $\frac{1}{2}$ feet.

ST ANDREWS, June 1887.

- (1) Sixty-nine million eighty-three thousand and seventy-six; 804005763.
- (2) £1295, 1s. 6 $\frac{1}{2}$ d.
- (3) £23,760, 6s. 9d.
- (4) 3 cwt. 26 $\frac{1}{2}$ lb. ($\frac{1}{4}$).
- (5) 7891 miles 3 fur. 12 po. 2 yd. 2 ft. 8 in.
- (6) 55,086,804 sq. inches.
- (7) 2754.
- (8) $\frac{1}{16}$.
- (9) 93 cuts.
- (10) $37\frac{1}{16}$ dollars; £7, 15s. 4d. $\frac{1}{16}$.

EDINBURGH, June 1888.

- (1) $\cdot\dot{3}1\dot{5} + \cdot00428571 + \cdot15625$
 $= \cdot47585102960$
 (2) $443\cdot0678391$; $63662\cdot03 +$
 (3) $\pounds296$, $17s.$ $6d.$ $+ \pounds11 +$
 $\pounds25$, $16s.$ $8d.$ $+ \pounds45 =$
 $\pounds378$, $14s.$ $2d.$
 (4) $\dot{4}1\dot{7}$
 (5) $\cdot6804$
 (6) $\pounds86$, $7s.$ $3\frac{1}{4}d.$
 (7) A , $8s.$ $8d.$; C , $\pounds1$, $10s.$ $8d.$

GLASGOW, May 1888.

- (1) Twenty-one million sixty-eight thousand and one.
 (2) 9575.
 (3) 1073 sixpences.
 (4) $\pounds2263$, $17s.$ $2\frac{1}{4}d.$
 (5) $19\frac{1}{2}$.
 (6) 6.
 (7) $\cdot041854703$; $410\cdot3$.
 (8) $\pounds63$, $19s.$ $8\frac{1}{4}d.$
 (9) $5\frac{1}{2}$ hours.

ABERDEEN, June 1888.

- (1) One million, eight thousand and sixteen; 1200000; 191984.
 (2) 87502680.
 (3) 16; 876.
 (4) $\pounds87$, $7s.$ $6d.$; 13 weeks.
 (5) $\pounds66$, $13s.$ $4d.$
 (6) 5.
 (7) 11 pieces; $\frac{1}{2}$ ft. remains.
 (8) $\cdot00003072$.
 (a) 6268; (b) $\cdot0006268$.
 $\frac{1}{16}$; $\frac{2}{16}$; $5\frac{1}{16}$.

ST ANDREWS, June 1888.

- (1) 733591.
 (2) $\pounds2061$, $19s.$ $10d.$
 (3) $\pounds29,111$, $2s.$ $7\frac{1}{4}d.$
 (4) 110 miles 3 fur. 33 po. $2\frac{1}{4}$ yd.
 1 ft. 4 in., or 2 yd. 2 ft.
 10 in.
 (5) 78,949 ounces.
 (6) 9 tons 3 cwt. 2 qr. $19\frac{1}{2}$ lb.
 (7) $\frac{11}{16}$.
 (8) $\frac{2}{11}$.
 (9) $\pounds1602$, $10s.$ $1\frac{1}{4}d.$

EDINBURGH, June 1889.

- (1) $69\cdot5892654$; $\cdot2103$.
 (2) $7\frac{1}{2}$; $\frac{1}{2}$.
 (3) 169; 389019.
 (4) $\pounds31$, $5s.$ $+ \pounds52$, $10s.$ $+ \pounds10$, $8s.$ $4d.$ $+ \pounds131$, $5s.$
 $= \pounds225$, $8s.$ $4d.$
 (5) $\pounds2$, $10s.$; $4\frac{3}{4}\%$ per cent.
 (6) $\pounds2$, $15s.$ $1d.$
 (7) 885 Danish crowns.

GLASGOW, June 1889.

- (2) 22836114579630.
 (3) $1207\frac{1}{2}$.
 (4) 63 sheep.
 (5) $5\frac{1}{2}$.
 (6) $54\cdot4107$.
 (7) $\pounds528$, $4s.$ $9\frac{1}{4}d.$
 (8) 59 ac. 1 ro. 6 po.
 (9) $\pounds4$, $18s.$ $2\frac{1}{4}d.$ $\frac{1}{2}$.

II. MEDICAL PRELIMINARY ARITHMETIC.

EDINBURGH, *March* 1886.

- (1) £3, 17s. 10½d.
- (2) 49 ac. 28 po. 10 sq. yd.
8 sq. ft. 112 sq. in.
- (3) £32,874, 18s. 7½d.
- (4) 3.741657 +
- (5) .0003188447 ; .00987.
- (6) 34½ ; 9.
- (7) 3½ per cent.
- (8) 660 men.
- (9) 51½ min. ; 34½ miles.
- (10) £153, 16s. 11½d. ;
£331, 8s. 6½d.

GLASGOW, *March* 1886.

- (1) 78214076605.
- (2) 6014.
- (3) 18 cwt. 8 lb. 7 oz.
- (4) £751, 16s.
- (5) 0.
- (6) ½ = .2½.
- (7) .375.
- (8) 141½ sq. yd.
- (9) 2½ per cent.
- (10) 6 hours 45 min.

EDINBURGH, *October* 1886.

- (1) £14,734, 14s. 2d.
- (2) 68 miles 1 fur. 29 po. 3½ yd.
1 ft. 7 in., or 4 yd. 0 ft.
1 in.
- (3) ½ ; 3½.

(4) .000025617103 ; 409300.

- (5) 19.104973 +
- (6) $1\frac{1}{11} \div 1\frac{1}{11} = \frac{1}{11} = .1571428$
- (7) £5, 10s.
- (8) 42½ per cent. gain.
- (9) A, 18 days ; B, 22½ days ;
C, 15 days.
- (10) £8400.

EDINBURGH, *March* 1887.

- (1) £16, 13s. 7½d.
- (2) 79 ac. 2 ro. 15 po. 25½ sq. yd.
- (3) ¾ ; 1½.
- (4) £56,002, 12s. 1d.
- (5) 3.78289375.
- (6) 4.123105.
- (7) 5s. 1½d. ¾.
- (8) £600, £600, £450, £400.
- (9) 120.
- (10) 33½ per cent.

GLASGOW, *March* 1887.

- (1) 18445115.
- (2) Q = 1225 ; R = 161.
- (3) ½.
- (4) 5.
- (5) £1404, 15s. 10d.
- (6) .0317377368.
- (7) .58027816 +
- (8) 3½ hours.
- (9) 2½ per cent.
- (10) £4, 3s. 6½d.

EDINBURGH, October 1887.

- (1) 76,015 gr. ; 33.156 per cent.
- (2) L.C.M. = 660660 ; $\frac{2}{3} \times \frac{1}{2} \times \frac{1}{3}$.
- (3) £689, 1s. 3d. + £120, 12s.
+ £9, 8s. 1½d.
= £819, 1s. 4½d.
- (4) 736.
- (5) 18.
- (6) 1.825.
- (7) £211, 15s. 10½d.
- (8) £1, 0s. 2½d.
- (9) 37.01.
- (10) 5 miles.

EDINBURGH, March 1888.

- (1) £87,250, 0s. 10½d.
- (2) 18.
- (3) £1.
- (4) 1½.
- (5) 5.322249 ; .012812904.
- (6) £1, 5s. 5½d. $\frac{1}{2}$.
- (7) 1.5 ; .6.
- (8) (1) .00000000125421875 ;
 (2) .2 ; (3) 200 ; (4) .00002.
- (9) 4½ per cent.
- (10) .19997 +

GLASGOW, March 1888.

- (1) 47254698.
- (2) 64913.
- (3) 8, 17, 1, 7.
- (4) 16.36848.

- (5) £26, 2s. 6d.
- (6) 32 men.
- (7) £253, 17s. 7½d.
- (8) 66 feet.
- (9) 33 sq. yd. 3 sq. ft. 50 sq. in.
- (10) 10 of each.

EDINBURGH, October 1888.

- (1) £83, 6s. 5½d.
- (2) 7560.
- (3) 1½.
- (4) .003625 ; .03625 ; .3625.
- (5) .2619047 ; $\frac{1}{2} \times \frac{1}{3} \times \frac{1}{4}$.
- (6) 39.370.
- (7) $\frac{1}{2}$ per cent. loss.
- (8) 25 years ; 6½ per cent.
- (9) £94, 10s. ; £7, 8s. 10½d.
- (10) 13½ days.

EDUCATIONAL INSTITUTE,
October 1888.

- (1) 309,431,128.
- (2) 7017.9941000 ; $10 \times \frac{1}{2} \times \frac{1}{3} \times \frac{1}{4}$.
- (3) 84 sqv. ; 1600 half-crs.
- (4) £89, 5s. ; £11, 15s. 9d.
- (5) 8s. 4d. + £3, 5s. + 4s. 6d.
+ 10s. 5d. + 13s. 4d.
= £5, 1s. 7d.
- (6) 10.
- (7) 4.
- (8) £1, 10s. 8½d.
- (9) 11½ hours ; 134½ miles.
- (10) ½ of a day.

LEAVING CERTIFICATE :

HIGHER GRADE, *June 1888.*

- (1) $2.14285\bar{7}$.
- (2) £6, 8s. 2d.
- (3) £941, 5s. $1\frac{1}{4}\frac{1}{4}$ d.
- (4) $£6\frac{1}{10}$ per cent.
- (5) £5253, 6s. 8d.
- (6) 7s. nearly.
- (7) 160.
- (8) $87\frac{1}{2}$.
- (9) $5041965\cdot1 +$
- (10) 1 ac. $1033\frac{1}{4}$ sq. yd.
- (11) Fifth son, $86\cdot77\%$; each of the others, $3\cdot305\%$.
- (12) 90 miles.

LOWER GRADE, *June 1888.*

- (1) $\frac{1}{11} - \frac{1}{11} = \frac{1}{11}$.
- (2) £45, 18s. 9d. + £8, 15s. $0\frac{1}{4}$ d.
+ £5, 18s. $1\frac{1}{4}$ d.
+ £15, 3s. $6\frac{1}{4}$ d. $\frac{1}{4}$.
= £75, 15s. $4\frac{1}{4}$ d. $\frac{1}{4}$.
- (3) 5751302.
- (4) £466, 19s. $2\frac{1}{4}$ d. +
- (5) 2s. $9\frac{1}{4}$ d. $\frac{5}{8}\frac{1}{8}$.
- (6) $28\frac{1}{4}$ sq. yd.
- (7) $\frac{1}{18}$ of half-a-crown.
- (8) (1) 2 ac. 3 ro. 1 po. $3\frac{1}{4}$ sq. yd. 5 sq. ft.;
(2) 2 lb. $14\frac{1}{4}$ drams.
- (9) 6 hours.

(10) $6\frac{1}{2}$ per cent.

(11) £112, 10s.

(12) 3·95121.

HIGHER GRADE, *June 1889.*

- (1) The first is least, the second is greatest. *
- (2) $69\cdot5701$ yd.
- (3) (1) $1\cdot89\bar{1}$; (2) 2s.
- (4) 9701 marks $86\frac{1}{4}$ pfenniga.
- (5) 173.
- (6) 2 per cent.
- (7) $39\cdot37$ inches.
- (8) $2\cdot1544$.

LOWER GRADE, *June 1889.*

- (1) 2 ac. 1 ro. 7 po. 9 sq. yd. 3 sq. ft. 36 sq. inches.
- (2) £22,931, 0s. 6d.
- (3) 13; 30030.
- (4) (1) $7\frac{1}{2}$; (2) $\frac{1}{11}$;
(3) $417\cdot9$ lb.
- (5) 469999·53.
- (6) £447, 9s. 5d.
- (7) £1809, 10s.
- (8) 2933.
- (9) 40375.
- (10) 65 per cent.
- (11) 6809.
- (12) 6 additional days.

TEST EXERCISES.

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(1) 593,776 bricks; £1237, 0s. 8d.
 (2) 576,640 drams.
 (3) 1.
 (4) 10s. 3d.
 (5) 3 hours 15½ min.
 (6) ·138.
 (7) £3, 10s.; 25 per cent.
 (8) £52,500; £21,000; £15,000.
 (9) 6 min.
 (10) £16, 17s. 6d.</p> <p style="text-align: center;">II.</p> <p>(1) Eight million nine hundred
 and eighty-six thousand
 two hundred and fifteen.
 (2) £2, 2s.
 (3) (a) $\frac{1}{4}$; (b) 5.
 (4) 1·0111.
 (5) 4½d.
 (6) £72, 11s 3d.
 (7) £3, 15s.; £2, 10s.; £1, 5s.
 (8) £2, 10s.
 (9) £30, 8s.
 (10) 1.10 P.M.; 11 m. from Edin.</p> <p style="text-align: center;">III.</p> <p>(1) One hundred and three thou-
 sand and forty-five.
 (2) 25,829 half-crowns.
 (3) 15 cwt. 10 lb.
 (4) 17.</p> | <p>(5) 52·1781.
 (6) 7·92 in.
 (7) 10 hours 44 min.
 (8) (1) 12s. 6d.; (2) 15s. 7½d.
 (9) 96 apples.
 (10) £2100; £75; £70.</p> <p style="text-align: center;">IV.</p> <p>(1) 38568062500.
 (2) 70,320 farthings.
 (3) 24 plots.
 (4) G.C.M. 13; £4, 0s. 10d.
 (5) 11½.
 (6) 3·2375.
 (7) £43, 6s. 3d.
 (8) £1250.
 (9) £625; A, £75; B, £125;
 C, £175; D, £250.
 (10) £14, 8s. 9d.</p> <p style="text-align: center;">V.</p> <p>(1) 900.
 (2) 18 cwt. 3 qr. 6 lb.
 (3) £250, 2s. 6d.
 (4) 10½.
 (5) 2s. 11d.
 (6) £10, 10s.
 (7) £61, 5s.
 (8) 4 hours; 15 miles.
 (9) £2240.
 (10) £41, 13s. 4d.; £37, 10s.;
 £30, 7s. 6d.; £27, 6s. 9d.</p> |
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VL

- (1) 12670240.
- (2) £5695, 7s. 0½d.
- (3) 4½.
- (4) 243400.
- (5) 8s. 10d.; £418, 15s.
- (6) £7.
- (7) 105 yd.
- (8) 19865.
- (9) .03105; 13½r.
- (10) £7, 10s.

VII.

- (1) 352408500.
- (2) £285, 18s. 4d.
- (3) 3 days 2 hr. 14 min. 40 sec.
- (4) £2, 2s.
- (5) .857142.
- (6) £525.
- (7) 2 lb. 7 oz.
- (8) 2s.; 25 per cent.
- (9) £1620.
- (10) (1) 3 ft. 6 in.;
(2) 73 sq. ft. 72 sq. in.
(3) 42 cub. ft. 1512 cub. in.

VIII.

- (1) £1,841,305.
- (2) 37440.
- (3) 1½, 1½, 7; 7; 1½, 1½.
- (4) 2½.
- (5) (1) 2 ro. 31 po.
(2) 8 oz. 14 dwt. 14·4 gr.

- (6) £10, 19s. 4½d.
- (7) £31, 12s. 9½d.
- (8) 24 people; £17, 10s.
- (9) 28½ min.
- (10) 5 lb. at 2s. 6d.
4 lb. at 3s.
3 lb. at 3s. 6d.

IX.

- (1) £45 + £9, 7s. 6d. + 8s. 4d.
+ £1, 0s. 10d. = £55, 16s. 8d.
- (2) (a) 1½; (b) 1½.
- (3) 17640000.
- (4) £1, 2s. 6d.
- (5) 1½ of a sq. inch.
- (6) 12½ days.
- (7) 8s. 2½d. 1½.
- (8) 4½.
- (9) £4, 3s. 4d.
- (10) 99, 10s.

X.

- (1) 1½ - 1½ = 1½.
- (2) 1½; 6½.
- (3) 35 times; .0008.
- (4) From France to Britain
8s. 4d.
- (5) 3½ per cent.
- (6) 1·8257; .5773.
- (7) 1320 yd.
- (8) £363, 12s. 8½d.
- (9) 2398·0158 kilogrammes.
- (10) 40 miles.

